VOLUME 4, NO. 3 JULY 1949

INTER-RELATED RESOURCES ..... R. Y. Bailey

DESIGNING AGRONOMIC PRACTICES TO MEET SPECIFIC EROSION HAZARDS ..... G. W. Musgrave

CROP RESIDUES CONSERVE SOIL AND WATER ..... James H. Stallings

AGRONOMIC PRACTICES IN RELATION TO WILDLIFE ..... Wallace L. Anderson

EFFICIENT USE OF FARM MANURE FOR EROSION CONTROL ..... George R. Free

IMPROVEMENT OF ITALIAN MOUNTAIN PASTURES ..... W. T. White

SEED HARVEST HINTS

FARMERS SHOULD KNOW

By widely publicizing educational information on proper seed harvesting, Allis-Chalmers has actively sought to improve seed quality, yield and germination.

Points to observe in efficient field harvesting from the standing crop or windrow are few in number but very important:

First, proper preparation. Beehives should be moved close to the fields in time for pollination. Livestock should be removed for 2 to 4 weeks before harvesting to allow seed pods to form.

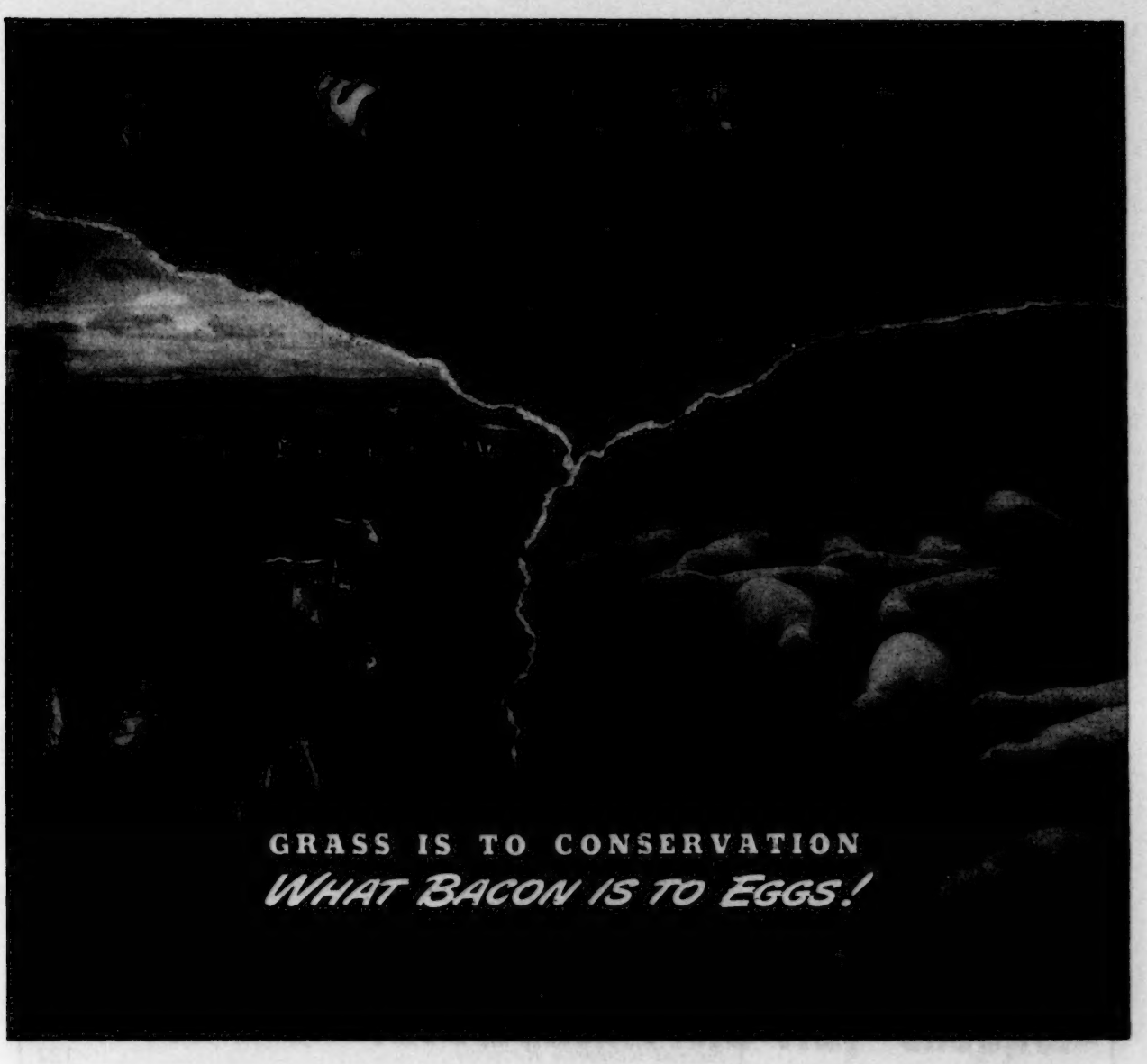
Second, proper timing. The Allis-Chalmers ALL-CROP Harvester was designed and priced to permit ownership by the individual farm, allowing the crop to be harvested at the right time without waiting on a neighborhood machine.

Third, proper operation. The speed of the ALL-CROP Harvester's wide rubber-faced bar cylinder is regulated as easily as dialing a radio to prevent skinning, crackage or damage to the seed germ. A variety of finishing sieves for all sizes and shapes of seed assures a good cleaning job.

Allis-Chalmers dealers are equipped for servicing ALL-CROP Harvesters to put more bright, clean seed in the bag. That means more money in the farmer's pocket and a more plentiful supply of seeds for the conservation program.

ALLIS-CHALMERS

TRACTOR DIVISION • MILWAUKEE 1, U. S. A.



Find a farm planned for soil conservation, and you'll find grass — grasses and legumes that bind soil against erosion, and build it up to produce the cultivated crops.

Find grasses, and you'll find livestock.

Find livestock, and you'll find better farming.

Grasses make inexpensive feeds, inexpensive to grow, inexpensive to harvest. This is partly because grazing livestock helps with the harvest, but there's another reason. Modern farm equipment is built to harvest the forages inexpensively. The power mower, the automatic baler, the field forage chopper, and the loader—such equipment harvests roughages fast and easy, puts them in stack, barn, or silo with less expense.

For soil conservation, there's a great combination —grasses, livestock, and power equipment.

John Deere

MOLINE · ILLINOIS

VOLUME 4
NUMBER 3

Journal of SOIL AND WATER CONSERVATION

OFFICIAL ORGAN OF THE SOIL CONSERVATION SOCIETY OF AMERICA

This JOURNAL is owned, edited, and published quarterly by the Soil Conservation Society of America.

OFFICERS AND COUNCIL
OF THE S.C.S.A.

L. E. PARTAIN ..... *President*
J. H. CHRIST ..... *First Vice President*
FIRMAN E. BEAR ..... *Second Vice President*
R. H. MUSSER ..... *Council*
E. H. GRAHAM ..... *Council*
WALTER HUMPHREY ..... *Council*
A. L. PATRICK ..... *Council*
RALPH H. WILCOX ..... *Council*
J. C. DYKES ..... *Council*
R. Y. BAILEY ..... *Council*
T. S. BUIE ..... *Council*
FRED A. WIRT ..... *Council*

Secretary
ALVIN C. WATSON
Room 411, Center Building
Upper Darby, Penna.

Treasurer
RUSSELL G. HILL
412 Agricultural Hall
East Lansing, Michigan

PUBLICATION OFFICE: 32nd Street and Elm Avenue, Baltimore 11, Maryland.

NATIONAL HEADQUARTERS AND SECRETARY'S OFFICE: Room 411, Center Building, Upper Darby, Penna.

POST OFFICE ENTRY: Entered as Second-Class matter in the Post Office at Baltimore, Maryland, August 28, 1946, under the Act of March 3, 1879.

MEMBERSHIP: Annual membership is on a calendar year and is $3.00 per year of which $1.50 is for subscription to the JOURNAL and .25 cents for NOTES AND ACTIVITIES. Subscription for the JOURNAL to Libraries and others is $3.00 per year. Single copies are 75 cents each.

CORRESPONDENCE—Concerning manuscripts, books for review and other editorial matters should be sent to the Editor, Room 608, Watson Building, Fairmont, West Virginia.

BUSINESS CORRESPONDENCE—Concerning remittances and questions should be sent to the Secretary, Room 411, Center Building, Upper Darby, Penna.

CHANGE OF ADDRESS: Notice of change in address should be received two weeks before the date of issue on which the change is to take effect. Both the old and the new address should be sent to the office of the Secretary.

REPRINTS: Articles appearing in this publication may be reprinted on condition that full credit be given the JOURNAL OF SOIL AND WATER CONSERVATION and the author; also the date of publication.

Contents for July 1949

Editorial 96

Inter-Related Resources 97
R. Y. BAILEY

Designing Agronomic Practices to Meet Specific Erosion Hazards 99
G. W. MUSGRAVE

Crop Residues Conserve Soil and Water 103
JAMES H. STALLINGS

Agronomic Practices in Relation to Wildlife 107
WALLACE L. ANDERSON

Pictorial Section 111

Efficient Use of Farm Manure for Erosion Control 117
GEORGE R. FREE

Improvement of Italian Mountain Pastures 119
W. T. WHITE

Recent Research Reviews 122
JAMES H. STALLINGS

Book Reviews 125

Field Notes 128

From the Editor 132

EDITORIAL OFFICE: ROOM 608 WATSON BUILDING
FAIRMONT, WEST VIRGINIA

WALTER C. GUMBEL, *Editor*

EDITORIAL BOARD

BEN O. OSBORN
LUNA B. LEOPOLD
FRED A. WIRT
E. H. GRAHAM
FIRMAN E. BEAR
DARRYL FRANCIS
DONALD A. WILLIAMS
RALPH WILCOX
B. W. ALLRED

Pick Up...Chop Up HAY or GRASS

This McCormick No. 75-P field hay chopper harvests 15 to 25 acres a day.

with the NEW McCormick Field Hay Chopper

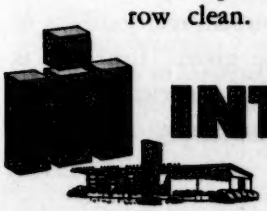
You can make hay or grass silage, when the crop is at the peak of perfection, with the new McCormick No. 75-P field hay chopper.

In one operation, you can (1) pick up your grass or green hay crop from the windrow, chop and blow it into a wagon or truck for hauling to the silo. (2) Pick up and chop green hay for barn drying. (3) Field-chop *dry* hay, ready to blow into the barn.

The McCormick field hay chopper has a 54-inch pick-up cylinder that sweeps the windrow clean. It chops the crop evenly and cleanly. Adjustments are available for lengths of cut from ½ inch to 4 inches. A swivel elbow on the elevator allows side or rear loading . . . assures proper loading position when turning corners so that no feed is wasted.

The chopper is driven from the power take-off . . . pulled by a Farmall H or M, or any tractor of comparable power.

Ideal for the family size farm, this one-man McCormick field hay chopper saves time—saves effort—saves your crop. See your IH dealer for more details—soon.



INTERNATIONAL HARVESTER

This modern building symbolizes the expanded service facilities of IH dealers throughout America.

180 NORTH MICHIGAN AVENUE • CHICAGO 1, ILLINOIS

Editorial

A comparative study of certain features of soil and water conservation in the United States for 1938 with that of 1948 is revealing. A pattern had already taken form in 1938 through Federal and State legislation that provided for the organization of soil conservation districts and conservation activities of other agencies in this field. Sixty-nine districts were in existence ten years ago as compared with 2,033 in 1948. There were 36 million acres in organized districts in 1938 as compared with 1,114,000,000 acres in 1948. Ten percent of the planned land was treated in 1938 as compared with 52 percent cumulative in 1948. 2,108 farm plans were written in 1938 and ten years later 109,673 plans were prepared.

It is clear that the scope of undertaking is larger than anything previously tried in this country; also there is a greater participation by farm owners and operators in the program. The district organization provides a framework through which "operations" assistance is made more concrete and in general is further developed than "educational" assistance. In spite of the effort the near total community or neighborhood accomplishment in soil and water conservation is still the exception rather than the rule. The natural neighborhood leader is about as likely not to be a conservationist as to be one.

In 1938 technicians representing the Soil Conservation Service worked principally with individual farmers in districts. Today there is a definite program underway in that agency to work with individuals in natural neighborhood groups. This approach does not change the kind of assistance previously provided farmers on an individual basis. It does, however, provide a more effective kind of assistance through the neighborhood leader and within the neighborhood group pattern.

Changes from the traditional experiences with land care are influenced by the different ways of living and believing that people have. A suggested change in farming may be quite acceptable to an individual from the technical viewpoint but quite unacceptable because of the cultural characteristics of his neighborhood group. For that reason, a neighborhood group leader can make a much more significant contribution to the group if he is a conservationist and practices conservation on his own farm. He can relate his experiences to the needs of others in his group for similar soil conservation experiences. Where group action in soil conservation is being undertaken with recognition of the cultural characteristics and the natural interdependence of people the question is raised as to whether educational resources are related well to the situation. It is one thing to deal educationally with natural neighborhood groups and leaders that are known and another where they are not known.

The development of 4-H club work in soil and water conservation would be almost entirely a field in which the initiative of the county extension workers would be depended upon. It is true that the soil conservation district governing body and others would have an interest in widespread extension work with boys and girls in soil conservation. The extension worker provides the educational "know-how." Contrasted with 4-H club work is assistance provided to a natural neighborhood group on the application of soil conservation already planned by the farmer and the farm planner working through the District. In this case the farm planner would take the initiative, for example, in determining technical assistance available to the group, the need for which is expressed through their leader. Almost certainly during this effort some learning will be accomplished—there will be some educational opportunities. The farm planner provides the technical information required and recognizes the opportunity to teach.

The important consideration is not whether it is an "educational" activity or an "operational" activity since learning by the farmer takes place in both these situations. It is whether those who are involved in soil conservation professionally recognize the framework of human relationships in which their assistance can be given. Learning is the result of the total impact of experience including professional advice and assistance.

Inter-Related Resources

R. Y. BAILEY

At the Third Annual Meeting of the Soil Conservation Society of America held in Cincinnati, Ohio, last December, a panel of ten distinguished conservationists under the Chairmanship of Fred A. Wirt, Advertising Manager, J. I. Case Company, Racine, Wisconsin, discussed "Soil, Water, Forests, Rangeland and Wildlife." All the papers were worthy of much more space than can be given in the *Journal*, but in order to provide members with a summary and point of reference, R. Y. Bailey of Spartanburg, South Carolina, was asked to review the papers. His straightforward resumé appears in the article that follows.

It was the material and discussions presented at this panel that caused the Society to pass a resolution calling for the creation of a National Land Policy which appeared on the Editorial page of the January 1949 issue of the *Journal*.

Dr. Edward H. Graham, Chief of the Biology Division, Soil Conservation Service, in opening the panel, discussed "The Nature of the Soil Resource." He based his discussion on the thesis that the soil is not a renewable resource.

Dr. Graham took sharp exception to a statement in a national magazine that tended to minimize the evil of erosion because there was experimental proof that subsoil produced 86 bushels of corn per acre—more than twice the United States average. He said that although subsoil produced 86 bushels an acre at the Ohio Agricultural Experiment Station in 1941, an adjacent topsoil plot made 125 bushels. He pointed out further that the average yield over a 9-year period was approximately two and a half times as much from topsoil as from subsoil.

The Status of Forestry in the United States was discussed in a thought-provoking way by Ralph F. Wilcox, State Forester of Indiana. Of the many phases of the forestry problem, Mr. Wilcox chose to deal primarily with timber production. He illustrated with charts the status of our diminishing timber supply and emphasized that future supplies cannot be mined from the original forests. These are so far used up that hereafter we must produce timber as a crop.

A complication in the production of timber is the large percentage of the timber land of the country that is held in relatively small tracts by private owners. Mr. Wilcox pointed out many of the problems in management of these small woodland areas. He emphasized the need of the small owner for specific help on the ground, *in the woods* in both production and harvesting of timber.

Lachlan Macleay, President, Mississippi Valley Association, gave an interesting discussion on Ground Water. He emphasized the substantial growth of industry in the Middlewest and the South and its influence on the ground water supply.

He expressed the belief that the answer to our ground water problem is in saving runoff so that it may be added to the ground water supply. He named soil erosion prevention as the most important problem before the country. He took a down-to-earth view of the way a soil and water conservation program will be accomplished through the efforts of individual landowners, rather than as a result of the "big-day" type of activity. The latter, in his opinion, gets front-page publicity, but falls short of good solid accomplishments. He wants to see landowners given adequate technical help in planning and doing the conservation job. He urged more adequate appropriations for the agencies giving this kind of help.

Stop Water Where It Falls

Elmer T. Peterson of the Oklahoma Publishing Company made a strong plea for a well-coordinated program to *Stop Water Where It Falls*. By examples ranging from runoff measurements on individual plots to farms and entire watersheds he told how water can be handled through the "insoak" process outlined in India as early as 1801.

Large dams built far downstream where they inundate valuable farmlands and stop mud *after* it leaves the land, instead of sound soil and water conservation measures on the upstream contributing areas, were sharply criticized. Mr. Peterson made it clear that he did not oppose all dams, but pointed out the futility of dams that were built in the wrong places after the damage

---

R. Y. Bailey is a Council member of the Soil Conservation Society of America and Regional Chief, Division of Agronomy, Soil Conservation Service, with headquarters at Spartanburg, South Carolina. He is an outstanding conservationist and the author of many publications and numerous papers featuring some phase of agronomy.

had been done. This paper deserves the careful study of every individual and group dealing with the problems of erosion prevention, flood control, and ground water supplies.

Irrigation; What is the Situation and What Can be Done About It?, was the subject of an interesting paper by C. E. Busby of the Soil Conservation Service. He said irrigation agriculture in this country was born in a water-shortage "atmosphere." He designated the watershed where the water originates, the artificial and natural means of getting water to the land, and the land where the water is used as the three principal parts of the irrigation problem.

The technical problems of getting water from its source onto the land where it is needed would seem to offer enough difficulties. These are further complicated by the uneven distribution of water and irrigable land. This shortage of water in many sections where it is needed brings into conflict the interests of different groups of people. Mr. Busby expressed the optimistic view that although *the problem involves land, water, and people in one unbroken chain from the watershed source of the water to the lower end of the farthest fields where any excess water drains away, something can and is being done about it.*

Drainage as a Factor in Land Use

Farm Drainage was discussed by P. W. Manson, Professor of Agricultural Engineering, University of Minnesota. The importance of drainage to get flat lowland into cultivation as a means of getting steeper slopes protected by ground cover was emphasized. The importance of deciding on whether or not to drain land on a basis of economic feasibility was pointed out. Mr. Manson made it clear that he did not recommend drainage for all swampland, and gave instances of ill-advised drainage projects that failed to pay their way.

Results of drainage investigations in Iowa were cited as evidence that drainage does not increase the severity of either floods or drought. Good soil management for drained land was emphasized. Cropping systems that include deep-rooted legumes to improve the structure of the soil and to supply organic matter improve the effectiveness of drainage systems. Soil conditions determine whether surface or subsurface drainage should be used. Mr. Manson emphasized in closing that drainage is one conservation practice that pays big dividends.

B. W. Allred, Chief, Regional Range Division, Soil Conservation Service, Fort Worth, Texas, sent a paper that was read by Ross Davies. In his paper Mr. Allred gave some slants on range management that were new to most of us who have been accustomed to consider the range purely for livestock production. He stressed the value of rangeland as a source of water for irrigation and industrial purposes and for recreation.

Here again the interrelationship of land use and water supplies was brought into focus. Allred gave examples of water intake from bare ground, soil under very light cover, and land under good cover. Land under good cover took in 8½ inches an hour, which was 17 times as much as was absorbed by bare soil. He also gave specific examples to show that total livestock production was greater on well-managed range that kept a good ground cover on the land than on overstocked range. He also told how people are working together in their soil conservation districts to solve their problems of range management and conservation. This cooperative effort by local people may be developed into a mightier force than could ever be brought about by control types of legislation.

Wildlife Management was discussed by Richard J. Dorer, Pittman-Robertson Coordinator, St. Paul, Minn. This paper was devoted primarily to wildlife management in Minnesota, but the principles are applicable elsewhere. The relationship between sound soil and water conservation and wildlife population was shown. The value of wildlife as a crop was said to have reached a total of more than $10,000,000 annually in Minnesota.

Food and Cover Provide Wildlife

The importance of ground cover in the conservation of wildlife was illustrated very strikingly by the losses of 5 to 35 per cent in the number of the pheasant alone during a blizzard in February 1947. This loss was negligible where there was good cover of trees or other vegetation and severe on burned, overgrazed, bare areas.

The Rev. L. H. Hass, Pastor of the Bethany Christian Church, Evansville, Ind., inspired the entire group with his excellent presentation of the Soil and the Church. The part of the church in the development of this country and its decline along with the decadence of land and agriculture were presented in a most impressive and arresting manner. The part the rural church is taking in awakening public consciousness of our land wastage problems also was described.

"The Church must generate a new spirit toward the land!" The best insurance for the continuance of family importance and stability in a community is good land ownership. The natural love of land in the hearts of people can be capitalized for the preservation of the soil. This appeal will transcend all other and reach the ancient love of home in the soul of man."

This paper served as a fitting benediction to end one of the best panels presented at this or any other public meeting. Every paper was good enough to warrant publication in its entirety.

Designing Agronomic Practices to Meet Specific Erosion Hazards

G. W. MUSGRAVE

Here is a paper that clearly defines the relationship of agronomic programs designed for meeting erosion hazards and crop production. The author points out that the objective of a soil and water conservation program is to improve and preserve the physical properties of the land. The results of such a program also increase crop yields. To bring about this relationship and understanding, the author discusses the interaction of forces and resistance, what rain does, and what agronomic practices can do.

THE DESIGN of an agronomic program to meet erosion hazards may differ in vital respects from an agronomic program designed to secure crop production. It is obvious that preservation of the physical well-being of the soil results in improved production. However, the primary objectives in a program of soil and water conservation deals with the preservation of the physical properties of the land. To do so with the greatest efficiency, we need a careful analysis of the dominant factors comprising cause and effect. The target at which we shoot must be clearly defined. One of the ways by which the target may be more clearly defined is outlined herein.[1]

For the present discussion, let us confine our thinking to the problem of soil erosion resulting from rainfall. While this problem differs somewhat in its analysis from that of soil erosion resulting from melting snow or from erosion produced by wind, the principles of the analysis are the same for any one of them.

The Interaction of Forces and Resistances

Erosion is the resultant of the interaction of certain forces and resistances. In erosion from rainfall we must deal with energies that often reach 2,000,000 foot lbs. per acre per storm. When this energy of rain impact is added to the further force of flowing turbulent water, severe erosion results unless protection in sufficient magnitude, and in proper time and frequency is provided.

Resistances to these forces are found in the vegetal or other cover that occurs upon the land at the time of the storm; in the inherent characteristics and condition of the soil; and in the various ways of impeding and retarding the flow of water on the land surface.

The agronomic practices are ordinarily the most feasible practices that the average farmer has at his command. They are likewise among the most effective measures for the control of erosion. The erosion-retarding effect of good cover on the land differs by as much as 1,000-fold from that of poor cover, this wide difference being due mostly to the so-called "umbrella" effects of a good vegetal canopy. Similar effects, however, come from dead vegetation used as mulch. Further protection is also provided in ways outlined in Table 1 where the forces involved in rain and the resistances resulting from agronomic practices are given in skeleton form.

TABLE 1. The Interaction of Forces and Resistances.

What Rain Does	*What Agronomic Practices Can Do*	
Provides energy to abrade, disperse, and erode soil.	(a) Intercept energy of rain (b) Intercept some volume of water (c) Modify rate of overland flow (d) Modify infiltration opportunity	Protective Effects[1]
Excess precipitation produces overland flow and transports soil.	(a) Modify soil porosity (b) Modify soil permeability (c) Modify soil aggregation (d) Modify stability of structure	Soil Conditioning Effects[2]
Excess precipitation produces rivulet, channel, and gully flow, causing cutting of soil mass.	(a) Modify soil moisture and amount of internal space	

[1]Must be present during rain.
[2]Must be established before rain.

What Rain Does

Rain provides energy of impact that abrades the soil, disperses the particles, and makes the soil particles more easily transportable. It is obvious that a single clay or

[1]There are of course additional ways. The elements of the problem of control of runoff waters was outlined as early as 1936 (see USDA Tech. Bull. 558). Recently a method of using hydrologic data for the design of a terrace system was shown by D. D. Smith (see Agr. Eng., June 1948). Other workers have dealt with this problem at various times.

G. W. Musgrave is Research Specialist for the Soil Conservation Service with headquarters in Washington, D. C.

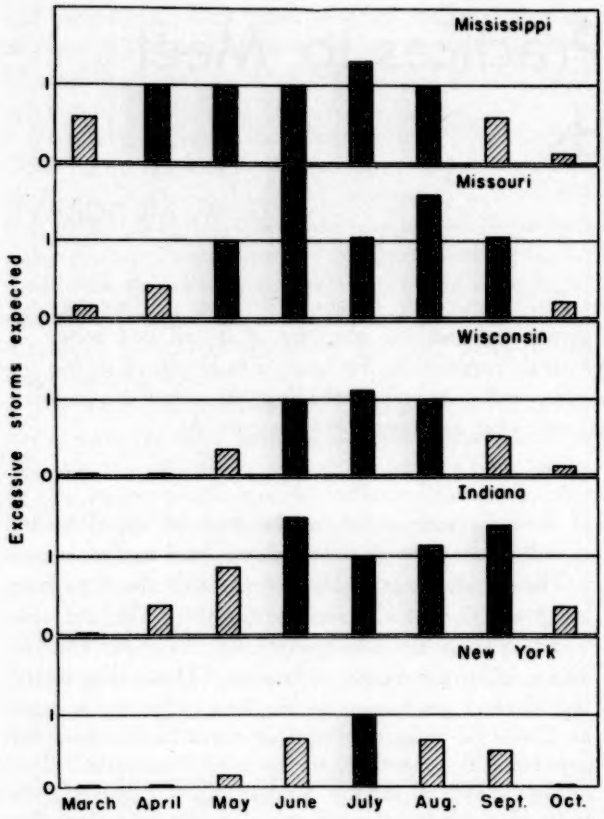


Figure 1.—The occurrence of excessive storms differs widely from month to month in different areas. These examples plotted from Yarnell's data show that the hazards from rainfall demand differing timing of protective measures from place to place.

silt particle is more easily transported than an aggregation of particles having a weight many times that of a single one. Then too, the rain that occurs in excess of the rate of infiltration provides water for overland flow and thus the means of transporting the loosened soil particles.

Furthermore, this excess rain—that is, the amount above that which infiltrates the soil—may produce rivulets, small channels, and gullies in which flowing water is highly turbulent and possesses great cutting power. This flowing stream or rivulet may loosen soil particles as well as transport them.

In the main these are the forces against which protection must be provided. We might go into greater detail and enumerate certain other forces that are contributing their effects, but because in most instances they are of small magnitude, the practical farm planner is justified in ignoring them.

What Agronomic Practices Can Do

Various well-designed agronomic practices will intercept the energy of rain impact. A dense cover of vegetation or a surface mulch of straw, or manure applied on the surface, are examples of practices that are extremely effective in intercepting the energy of rain impact. Many studies by many workers have clearly shown the importance of this "umbrella" effect.

These same agronomic practices also intercept a certain volume of water, so that less water reaches the ground surface than would be the case otherwise. From ¼ to ½ an inch of rain may readily be held upon the leaves and stems of a dense cover. These dense types of vegetation also greatly modify the character and reduce the rate of overland flow. Where a dense vegetation exists, it has been shown by ample research evidence that the depth of water on the land surface is greater, turbulence is less, and the velocity of flow is spread out between the peak rates that otherwise would occur as a result of surges of the storm.

Because of the greater depth of water on a land surface having dense vegetation, infiltration opportunity is increased since the surface water then covers more of the miniature hummocks that are present in any field. Many of these miniature hummocks that occur under small grass clumps, for example, are particularly permeable. Because of this increased infiltration opportunity, the amount of overland flow is less than would otherwise be the case. All of these above-mentioned effects of agronomic practices may be termed "protective effects." They are the kinds of effects that are needed during the rain.

In addition to them, there are other results of crop and soil management that may be termed "soil-conditioning effects." These soil-conditioning effects must be established before the rains occur. They may disappear in part during the course of the storm and are usually less effective upon the quantity of runoff and erosion that occurs, but they are nevertheless highly important. Among these effects are the results of organic matter and proper land treatment, modifying soil permeability, soil aggregation, and particularly the stability of soil aggregates in the presence of water. All of these effects have been well established by the reseach of many different workers.

In addition to those enumerated, there are still others which are of lesser magnitude normally and which, for purposes of brevity, we may ignore at the present time. It is important, however, to note that agronomic practices are the principal means by which the damage produced by the impact of intense rains may be modified in farm practice.

Rain Intensity and Erosion

Our research evidence shows clearly that in most instances the great proportion of erosion is the result of a small number of rains. In some cases as much as 80% of the annual soil losses may be attributed to a half dozen or so intense storms. In practically all cases, more than half of the annual erosion may be attributed to a small proportion of the total number of rains occurring during the year. By examination of the weather records for the locality it is possible to identify the season or seasons of the year when these few erosion-producing storms usually occur.

TABLE 2. Examples of the Primary Erosion Control Target.

RELATION OF RAIN INTENSITY TO EROSION IN NEW YORK[1]

Rains No.	Max. 15-Min. Amount Inches	Erosion per Storm Lbs./A	Percent of Total Erosion	
55	0.13	8		
29	0.16	57		
33	0.19	232		
12	0.29	721		
27	0.38	1594		
9	0.54*	3527	16.1	65
10	0.68*	5704	31.9	
2	1.00*	14427	17.7	

*Classed as "excessive storms" by Weather Bureau.
[1]Lamb, Andrews, Gustafson. Cornell Bulletin 811. March 1944.

RELATION OF RAIN INTENSITY TO EROSION AT CLARINDA, IOWA[2]

No. of Storms	Percent of Total Erosion
2	18
16	60
128	100

(54% of total erosion from Corn occurs in May and June.
55% of total erosion from Oats occurs in May.)

[2]Based on data in USDA Tech. Bull. 959, October 1948.

Storms of intensities equaling or exceeding those which are starred in this table are those which have been termed by the Weather Bureau "excessive." In soil conservation work we probably could refine this classification somewhat and show the variation in intensity of rain that is required to produce erosion on soils differing in permeability and erodibility. This, however, can be developed now only in certain local areas where sufficient information is available.

The numbers of these excessive storms that occur in different months of the year have been shown by Yarnell.[2] An examination of his charts for the eastern half of the United States shows the high frequency of such storms occurring in Texas, Oklahoma, and Kansas in May, as well as in Florida and Alabama. In June a large number of these storms occur in Indiana, Arkansas, and Kansas. The charts clearly indicate that in different parts of the country in different months the expectation for excessive storms differ widely. The distribution of excessive storms by months for several states is shown in Figure 1.

2Yarnell, David L. Rainfall intensity-frequency data. U. S. Dept. of Agri. Misc. Pub. 204. Aug. 1935. Although some inaccuracies are now known to exist in these charts, they are generally useful and applicable to broad examinations of rain intensities. Locally they may be refined in precision, particularly where there are long-time records of the local rainfall.

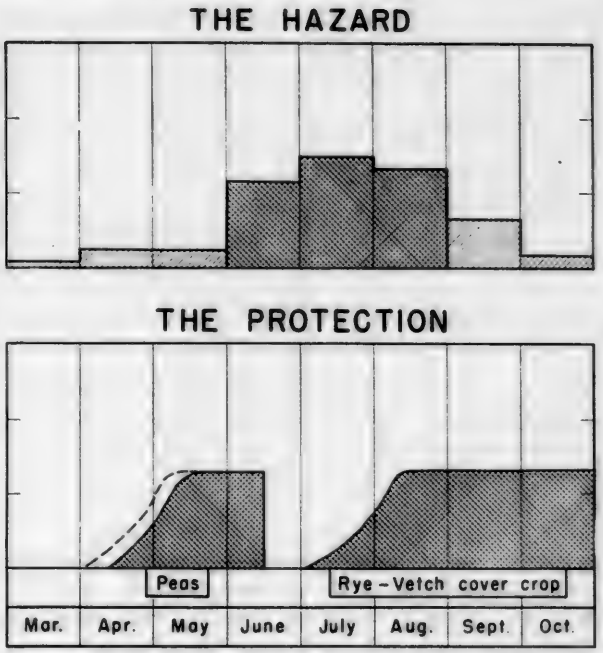


Figure 2.—Schematic outline illustrative of a gap in the protection provided by a crop in a rotation and the following winter cover crop. On this farm the application of organic matter, fertilizers, crop rotation, cover cropping, and contouring are not in themselves all-sufficient even though the slopes are mild and the soil relatively permeable.

In designing erosion control measures, whether they be agronomic or another type, one of the most important considerations is to have the protection that is provided by the treatment coincide with the erosive force both in time and sufficient magnitude. For example, a good winter cover crop provides inadequate protection against erosion that occurs in midsummer. This is illustrated in Figure 2, where peas for a canning factory are harvested in the season of most excessive storms—namely, mid-June.. Any soil-conditioning effects of even excellent cover crops cannot provide protection against the high-intensity mid-summer storms that usually produce the bulk of the annual erosion. It is obvious that between the time of pea harvest and that of attaining good ground cover by rye and vetch, some additional pro-

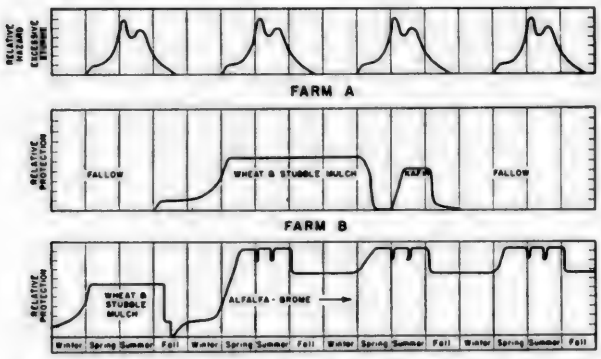


Figure 3.—Schematic outline illustrative of the occurrence of the hazard (excessive storms) and of the protection (obtained from agronomic practices) on two different farms in the same area during a four-year period.

tection is essential. Whether this can be provided by crop residues left on the surface or by other means depends upon many local conditions and requirements. This figure serves merely to point out the need and perhaps the type of research that is needed.

Another example is outlined in Figure 3. Here the most hazardous period is June, August, and July. These are the months when the frequency of excessive storms is greatest where these farms are located. On Farm A no protection is provided during the period of black fallow preceding wheat. During the wheat portion of the rotation, fair protection is offered after the wheat reaches the stage of providing a good canopy. Where the straw and stubble are left on the surface, this protection is continued. The following year, a hazardous period appears from the time of seeding kaffir until it provides a good canopy.

On Farm B, however, located in the same area, the alfalfa-brome mixture provides excellent protection throughout each hazardous period. In addition, it provides considerable soil conditioning against the future wheat year.

These instances are but examples taken from widely differing areas that point to the need for a careful examination of each local soil conservation problem. If the farm planner can first determine the specific circumstances under which the bulk of the erosion occurs, he is then in position usually to examine the dominant hazard in some detail. This may be snow, or wind, as well as rain, depending upon the conditions in different areas. The normal magnitude, time, and frequency of occurrence may be closely estimated. Once this is done, the target is more clearly identified. Treatments to meet the dominant needs may be designed with greater efficiency.

These procedures are applicable to research planning no less than they are to farm planning, because a good plan, among other things, requires a sharply defined objective.

Watersheds and How to Care for Them

The soil and the underlying rock mantle is the key to understanding the control of water on the land. Soil is capable of storing water. Some of this water is retained by the soil just as water is held behind a dam. But the soil also releases water when the mantle is filled to capacity.

Soils on forest and range lands can absorb and retain against the force of gravity from 1 to 3 inches of water per foot of mantle depth. Fine-textured soils with a high content of organic matter have a greater retention-storage capacity than coarse soils—a dry soil mantle 4 feet deep can absorb and hold from 4 to 12 inches of rain or water from melted snow without yielding a drop of runoff. This retention-storage function is the same as that performed by a dam. Removal of the soil by erosion, or otherwise, reduces the capacity of a site to retain water and so increases the chances for greater runoff and flood discharges in the same way as would the lowering of a dam.

Retention storage is only one of the storage functions of the watershed mantle. After a soil mantle is wet to its capacity to hold water against the force of gravity, it is not yet saturated. Air space still remains between the wet soil and rock particles. This additional storage space may be equivalent to as much as 2 inches a foot of mantle depth. Water that enters these spaces is not retained by the mantle but moves downward to the subsurface aquifers, where it may replenish the ground-water levels, or may emerge in channels or at springs to sustain stream flow.

The percolation of the freewater through the soil and rock mantle of a watershed takes time—much longer than the escape of water over the spillway of a dam. The slowness of the percolation process is attested by the fact that streams continue to flow for periods as long as a year after free water disappears from the soil mantle.

The delayed yield of water is one of the most important and valuable functions of watershed lands. Communities and industries pay millions for a sustained yield of water and one of the major purposes of billions of dollars worth of dams is to catch spring floods and make them useful in the autumn droughts. The same functions are performed by the soil on many millions of acres of forest and range watershed lands. These natural and beneficial functions of the soil must be maintained through good management.

—George W. Craddock and Charles R. Hursh,
Yearbook of Agriculture 1949

Crop Residues Conserve Soil and Water

JAMES H. STALLINGS

The use of crop residue as a means of reducing runoff and soil loss by erosion is growing in importance. Recent experiments point to several definite conclusions such as increasing the organic content in the soil, improving the aggregate structure and maintaining a high infiltration rate. The author also points out that the many experiments thus far conducted show that where residues are left on the surface and properly worked into the soil, crop yields are materially increased.

ANY FORM OF CROP RESIDUE is more effective in reducing runoff and soil loss by erosion when kept on the surface of the ground than when turned under. This practice is also a more effective way of building up the organic matter content, of improving the aggregate structure and of maintaining a high infiltration rate of the soil than turning it under. In many cases residue on the ground surface is equally satisfactory in maintaining a high level of crop production.

Vegetal covers, whether living or dead, accomplish these objectives. Likewise, residue material, whether left on the surface or turned under, is superior to no crop residue. The use of crop residue on the surface offers a satisfactory means of supporting those places in crop rotations where the rotation crops themselves do not provide adequate protection for the soil against the action of the raindrop during hazardous periods of high impact storms. The vegetal cover absorbs the energy of the falling raindrops and prevents the destructive action of their beating on bare land. The chief function of crop residues and other vegetal covers in reducing erosion is energy absorption, or protection from raindrop impact and not the impediment of overland flow.

Raindrop splash is the chief cause of erosion on cultivated land. When raindrops strike the ground or the thin films of water covering it, during hard beating rainstorms, these splashed particles in addition to being thrown down hill fall into moving surface water and are carried away. Crop residues or other vegetal covers protect the surface of the land from the falling raindrops and prevents splash erosion from taking place. Without this splashing of the soil, which starts the erosion process, there will be but little erosion occurring on farm land.

James H. Stallings, Author of "Recent Research Reviews"—a regular feature in the JOURNAL—is widely read. He is a Research Specialist in the Soil Conservation Service with headquarters in Washington, D. C.

Vegetable matter, in order to be effective in controlling erosion, must be placed on the surface of the ground where it will intercept the falling raindrops, absorb the energy contained in them and ease the water onto the ground without setting in motion the chain of damaging reactions which the impact of the raindrop starts. In addition to keeping soil in place vegetal covers also prevent the splash process from removing the organic matter originally in the soil. It permits more of the organic matter added as crop residues, manures, and cover and green manure crops to accumulate, which results in a more rapid rate of building up the organic matter content of the soil.

It makes little difference whether the crop material is living or dead. Completeness of the ground cover is the chief factor in determining its effectiveness. There is little indication that plant roots in themselves have much effect on the infiltration capacity of the soil or on the splash process.

A favorable aggregate structure can be built up much more quickly and satisfactorily by leaving the crop residues on the surface of the ground than by turning them under. Soil heavily mulched for a period of years has developed a better aggregate structure than similar soil sodded to bluegrass or soil on which the best cover crop and cultivation system yet devised was practiced. This improved aggregate structure and the elimination of the surface sealing, which occurs during rainstorms on unprotected or inadequately protected soil surfaces, results in more rapid infiltration and less runoff and soil loss.

In light of the facts stated above it is not surprising that this method of utilizing manures and crop residues frequently result in higher crop yields than the conventional method. Surface utilization of these materials has led to substantial increases in crop yields in many instances. Further investigation doubtless will reveal satisfactory methods of overcoming the depressing effects of mulch covers on crop yields, where they occur, and lead to even greater increases under those conditions

producing superior yields now. Those places in crop rotations where the rotation crops themselves fail to supply adequate protection against the falling raindrop can be sufficiently fortified by surface utilization of crop residues.

The proper use of these materials offers the most effective single measure of reducing erosion and runoff and bringing about other desirable conditions in cultivated soils leading to continued high production. To be sure, we do not have the final answer or answers to the correct use of crop residues, nor of other vegetal covers, in this capacity. We do have enough information, however, to indicate that these hold the key to the erosion control problem on cultivated land.

Our present situation in this connection may be compared with the Wright brothers' first attempt to fly an airplane. The research data available to them indicated it was impossible to build a machine that would fly. Once they proved their point research engineers busied themselves with building better machines. We now have found a practice that will control raindrop splash. Since our objective is to save our soil, we have a far greater incentive for forging ahead with a program which has for its aim more complete knowledge of the proper ways of utilizing crop residues and other vegetal covers in conserving our soil and water.

Duley and Russell (5) found that where water was applied artifically to 0.005-acre plots at the rate of about 1.5 inches per hour to simulate rainfall, wheat straw stubble left on the surface almost completely eliminated erosion and reduced runoff about 95 percent over that of a bare cultivated Marshall silt loam with a four per cent slope. Out of a total of 15.33 inches of water applied to the bare cultivated soil 6.27 inches entered the ground and the other 9.06 inches ran off taking 3.44 tons of soil per acre with it. At the same time 15.54 inches, out of 15.96 applied to a similar soil covered with combine wheat stubble, entered the ground leaving only 0.42 inch to runoff, which carried 0.03 ton of soil with it.

The foregoing results compared favorably with results obtained under field conditions during the fallowing seasons of 1939-41, inclusive. The average annual rainfall for the three fallow seasons, which included the period of April-September, was 12.43 inches. The average annual runoff for the period was 1.97 inches for a disked plot which received no organic matter, 1.39 inches for a similar plot receiving two tons of wheat straw disked in, and 0.60 inch for a plot receiving two tons of wheat straw and subtilled. The soil losses per acre were 13.04 tons for the disked plot, 6.24 for the straw disked in, and 0.97 ton for the plot subtilled.

During this period the plot with the straw disked in, lost more than twice as much water by runoff and six times as much soil as where the straw was on the surface. Bare disked land lost three times as much water and 13 times as much soil as an adjoining stubble plot with residues on the surface.

Woodburn (17) found that two tons of straw, applied as a mulch after the land had first been cultivated, reduced erosion to 0.1 ton per acre and the runoff to six percent. During the same period a bare soil lost 21 tons of soil and 44 per cent of the rainfall as runoff. The experiment was conducted on Houston clay. The time extended from July 1 to December 31, 1942 during which a total of 14.83 inches of rain fell.

Peele (14) found that oat hay and crimson clover used at the rate of 2.5 tons per acre as mulching material reduced runoff and soil loss on four different soil types during the period of June 16 to November 23, 1944. The average runoff for the four soil types was 18.04 per cent for bare land, 1.25 for oat-hay mulch and 0.33 for crimson-clover mulch. The soil loss was 2,428 pounds per acre for the bare land, 61 for the oat-hay mulch and 20 for the crimson-clover mulch. An average of 14.5 inches of rain fell during the period.

The use of 4 tons per acre of crimson clover and Kobe lespedeza, as a mulch on Cecil clay, reduced runoff from 48.4 per cent of the total rainfall of 94.43 inches to 3.5 percent, and the soil loss from 178,300 pounds per acre for an unmulched plot to 1,500 pounds per acre for the mulched plot. The period covered was August 1939 to January 1942.

Hendrickson, Carreker and Adams (7) report soil loss of 12.57 tons per acre and runoff 32.75 percent of a total rainfall of 25.27 inches for unmulched soil for the period of April to September 1940, compared with corresponding losses of 2 tons of soil and 1.43 percent of rainfall as runoff for soil mulched with three to four tons straw per acre.

The primary effect of vegetal cover in reducing runoff and soil loss was generally conceded to be due to the impediment it offered to overland flow until Borst and Woodburn (2) showed it to be due to the de-energizing of the rain drop instead. They applied artificial rain to three series of plots at the rate of approximately 2.25 inches per hour. The plots were left bare and exposed to the action of natural rains for some weeks. During this period the surface soil became crusted or "sealed". Two of these series of plots were then covered with straw at the rate of two tons per acre. In one series, the straw was placed directly on the ground and in the other it was supported one inch above the surface of the ground on chicken wire. The third series was left bare. Artificial rain was then applied at the above-mentioned rate. It was found that 92.7 percent of the water

applied ran off the bare plot compared with 65.0 percent for the plot with the mulch placed directly on the soil and 83.2 percent for the plot where the mulch was supported one inch above the ground. The corresponding soil losses for the three plots were 5.62 tons per acre for the bare, 0.42 ton for the first mulched plot and 0.26 ton for the mulched plot where the straw was supported one inch above ground.

These figures show that the mulch was not very effective in controlling runoff when applied after the surface of the soil had become sealed but did materially reduce the rate of soil loss. Had surface flow been the chief factor in bringing about erosion, the rate of soil loss should have been much higher on the plots where the mulch was supported one inch above ground than on the plot where the mulch was placed directly in contact with the soil.

Mulch Reduces Runoff and Erosion

Further light was shed on this point by use of two additional series of plots on which the surface of the soil was broken to a depth of about one inch and straw mulch applied at the rate of two tons per acre. In one series the mulch was placed directly on the surface of the ground and in the other it was supported one inch above the surface on chicken wire. Water was applied at the usual rate of 2.25 inches per hour.

The mulch in this instance almost completely eliminated both runoff and erosion. The plot with the mulch resting directly on the surface of the ground lost 1.7 percent of the water applied as runoff and 0.10 ton of soil per acre. The other plot lost 1.2 percent of the water applied as runoff and 0.12 ton of soil.

These studies show that the chief function of the straw was energy absorption or protection from raindrop impact and not the impediment of overland flow.

Lamb (11) found that 10 tons of manure used as a top dressing after planting consistently saved much more soil and water than did 20 tons plowed under during the period 1943-48, inclusive, and produced as satisfactory crop yields. At the end of the sixth year of the experiment the level of organic matter of the soil appeared to be more closely related to the method of application and the amount of erosion that occurred than to the amount of manure applied.

Lamb, Andrews and Gustafson (12) reduced the loss of water to less than one-half and the loss of soil to less than one-fourth by leaving 750 pounds of buckwheat straw per acre on the surface as a mulch. Records for two years show that plots with residues plowed under lost an average of 2.4 inches of water and 2.2 tons of soil an acre, for the period June 10 to December 1 of each year 1942 and 1943.

Six tons of straw mulch per acre on Groton soil with a slope of 35 to 45 percent reduced runoff on the average from 1.93 inches for fallow to 0.16 inch and soil loss from 9,132 pounds per acre to only a trace during the period May through October during each of the three years 1940-42. Soil mulched with an average of 12 tons of straw per acre per season for 1939-40 produced an average acre yield of 7,125 pounds of grapes compared with 5,325 pounds for a similar area clean cultivated. In 1941 there was little difference in yield, and some evidence of late growth and winter injury caused by an over supply of nitrogen was noted.

Van Doren and Stauffer (16) reported that soil losses ranged from 14 to 149 times greater from unmulched plots than from plots protected by straw mulch. Wheat straw, corn stover and soybean residue were the materials used. Alderfer and Merkle (1) found that mulches composed of manure, straw, sawdust, corn stover, oak leaves and pine needles completely eliminated runoff on Hagerstown silt loam where water was applied at the rate of 1.5 inches per hour. Three and four years of mulching with these materials resulted in complete control of surface runoff and effected an infiltration capacity equal to, or in exces of, three inches per hour.

In addition to controlling runoff and erosion more effectively when left on the surface than when turned under crop residue on the surface builds up the organic matter content of the soil at a faster rate than when turned under. Moser (13) found that by turning under four tons of crimson clover per acre the organic matter content of the soil was increased from 1.75 percent, where no residue was applied, to 2.52 where the crimson clover was turned under. When applied to the surface as a mulch the organic matter content of the soil increased to 2.54 percent. Under similar conditions where lespedeza residue was allowed to accumulate to form a natural mulch the organic matter content of the soil increased to 3.74 percent.

Peele (14) found that by using four tons of Kobe lespedeza hay per acre as a mulch the runoff was held to 3.4 percent of a total rainfall of 94.43 inches during the period under study. The soil loss was 1,500 pounds per acre. An adjoining plot which had four tons of Kobe lespedeza hay turned under lost 42.7 percent of the total rainfall as runoff and 107,700 pounds of soil per acre.

Alderfer and Merkle (1) found important differences in the organic matter content of the soil at three different depths at the end of the fourth year in favor of leaving crop residue on the surface rather than turning it under. The organic matter content was determined for 0-1 inch depth, 1-3 depth, and 3-6 inch depth in each case. The mulched plot had 3.72 percent organic

matter for the 0-1 inch depth compared with 2.71 percent for the plot where the crop residue was turned under. Corresponding figures for the 1-3 inch depth were 3.11 percent for the muched plot and 2.89 for the plot where the residue was turned under, and 2.75 and 2.55 percent, respectively, for the mulched and incorporated plots for the 3-6 inch depth. These figures are the averages for six different kinds of organic materials used.

Van Doren and Stauffer (16) found that soil aggregation was very definitely favored by mulching with straw. Alderfer and Merkle (1) found that the average stability index of the soil was definitely higher in each depth, namely, 0-1 inch, 1-3 inches, and 3-6 inches where the crop residue remained on the surface than where turned under. The stability index for the 0-1 inch depth was 57.9 on the mulched plot compared with 54.2 on the plot where the residue was turned under. Corresponding figures for the 1-3 inch depth were 59.0 and 55.9 and for the 3-6 inch depth 60.7 and 58.8.

Havis (6) found that Wooster silt loam soil reached a relatively high state of aggregation under straw mulch such as that often applied around fruit trees. This condition is reached quickly if the mulch is of unleached wheat and alfalfa. Bluegrass sod treatment over a long period is of value in increasing and maintaining a high percentage of the aggregates of the larger size but is not as effective as mulch. Cultivation, even with such cover crops as can be produced in a mature apple orchard, is very destructive of soil aggregate structure. Mulch has a value in the formation of aggregates which is out of proportion to differences in organic matter present.

Kidder, Stauffer and Van Doren (9) found that total infiltration was greatly increased by the presence of wheat straw mulch on three different occasions. Tests were made in June 1941, October 1941 and again in April 1942 on soybean and corn land. The average total infiltration for the first 60 minutes for the three different dates and the two crops was .56 inch on the bare land and 1.67 on the mulched soil. Findings of other investigators verify these results.

Crop yields are also higher in some instances where residue material is left on the surface than where turned under. Hendrickson and Crowley (8) obtained as high or higher yields of lespedeza hay during 1939 and 1940 from eroded abandoned land that had been mulched as from ordinary farm land in the vicinity which was cultivated the conventional way. A complete failure was experienced where lespedeza was planted on eroded abandoned land that was not mulched, however. These mulched eroded abandoned areas produced 282 pounds of lespedeza seed per acre in 1942. This equaled or exceeded the seed yields obtained on the best of the cropland fields. Peele (14) secured higher corn yields on four different soil types where mulches were used than where no mulching material was used. The average acre yield for the four soil types where no mulch was used was 17 bushels. Comparable plots mulched with oat hay produced 21.3 bushels and other plots mulched with crimson clover produced 28.4 bushels per acre. Copley, Britt and Posey (4) found that flue-cured tobacco produced greater yields, when mulched than when not mulched, during years of normal or below normal rainfall. However, the yields on the mulched plots were lower than those of unmulched plots during seasons of excess rainfall. Duley and Russell (5) report an average annual acre yield of 28.3 bushels of corn on unmulched land for the three year period 1939-41, compared with a yield of 36.8 bushels for land mulched with two tons straw per acre. They also found that corn yields were higher on land where the straw was left on the surface than where it was turned under. Corn following small grain with the stubble plowed under produced 21 bushels per acre compared with a yield of 27.3 bushels per acre where the stubble was subtilled.

Van Doren and Stauffer (16) found that the use of two tons of wheat straw per acre as mulch depressed corn yields, increased soybean yields slightly, and did not affect the yield of hay materially. Mulched corn land produced an average annual acre yield of 76.5 bushels of corn for the three year period 1941-43 compared with a yield of 92.7 bushels for unmulched land. During the same period soybeans produced 31.5 bushels per acre on the mulched land and 29.2 bushels on the unmulched land. The corresponding yields of hay were 3.17 and 3.19 tons per acre.

Van Doren, Lang and Waggoner (15) found that the depressing effects of mulch on corn yield was overcome when the soil was fertilized. The average acre yield of corn on unmulched land on four farms in 1943 was 65 bushels per acre compared with 64 bushels for mulched land. Similarly the average acre yield of unmulched land on five farms in 1944 was 79.6 bushels per acre compared with a yield of 77.9 bushels per acre for mulched land.

Borst and Yoder (3) found that alfalfa could be grown successfully on severely eroded abandoned land without preparing the seedbed the customary way but by utilizing the poverty grass and broomsedge growth on such lands as a mulch. The land was limed, fertilized and disked so as to cut up the sod cover in such a way as

(*Continued on page* 127)

Agronomic Practices in Relation to Wildlife

WALLACE L. ANDERSON

Wildlife in America largely depends upon an increased understanding between land management biologists and agronomists. This paper tells how the direct application of many agronomic practices contribute to the real value of wildlife and to a resultant better biological balance of farm and ranch lands. It also relates how the land management biologist helps to bring about an increase in desirable kinds of wildlife, a decrease in those that are harmful to useful plants and animals, and to maintain a reasonable balance between living things and land use practices.

THE INCREASED CONSIDERATION being given to agronomic practices in relation to wildlife is most encouraging. It represents an increasing recognition of the basic relationships that exist between land, plants, and animals. The exchange of ideas and information between land management biologists and agronomists is a healthy development that will be increasingly important in the conservation of natural resources.

The land management biologist is a new kind of technician whose job, as stated by Graham (1944), is ". . . to look to the relation between the management of rural land, whether it be cropland, pasture, range, woodland, or wildlife land, and the complex of plants and animals which attends such management. . . . His task is (1) to increase populations of species that are esteemed for their economic, recreational, aesthetic, or other values, (2) to decrease populations of those species that are harmful to useful plants and animals or otherwise injurious, and (3) to maintain a reasonable balance between communities of living things and land-use practices." Proper agronomic practices will certainly contribute much to the successful accomplishment of the land management biologist's job, and it is not entirely impossible that the land management biologist may uncover techniques that will aid agronomists in the successful application of agronomic practices.

The plants and animals dealt with by the land management biologist are commonly called "wildlife." For the purpose of this discussion we will define "wildlife" as "all kinds of plants and animals that maintain and reproduce themselves without human assistance." Note that this is a broader definition than one commonly used which limits wildlife to "undomesticated vertebrate animals."

Wildlife is a crop of the land, just as are corn, grain, hay, or pasture. It is different from other farm crops in that it is not seeded periodically, but it is similar in that it must have a suitable environment in which to grow. Attempts at "reseeding" in the form of artificial propagation and release of game birds in unsuitable environments have failed just as completely as attempts to grow corn on poorly drained or badly eroded land.

Wildlife is an important crop, as indicated by Dambach and Leedy (1948) in their evaluation of Ohio's wildlife resources. They found that the value of wildlife products harvested in Ohio in 1946 totaled $14,486,000 and that the aggregate value of the business produced was approximately 75 million dollars. This is nearly equal to the 1942 cash farm income in Ohio from corn, wheat, and soybeans which totaled $77,507,000 (Ohio Development and Publicity Commission, 1944). These figures do not include the biologic values of wildlife, such as polination of legumes and fruits, soil improvement, and reduction of insect and other pest damage to farm crops.

Not only is wildlife a crop of the land, but there is some land that is best suited to produce useful wildlife, just as some land is best suited for cropland, some for permanent hay, and some for pasture or range. The types of land best suited for wildlife production include drainage ditch banks, fence rows, field borders, marshes and swamps, odd areas, ponds, streambanks, and windbreaks.

Wildlife, unlike other farm crops, such as corn and grain, does not necessarily stay on the land designated and especially prepared for its use. It is a more or less mobile crop—at least the animal varieties of wildlife are. The degree of mobility differs for different species, ranging all the way from wild plants that do not move at all; through such species as quail and rabbits that generally restrict their daily movements to an area having a radius

Wallace L. Anderson, Chief of the Regional Biology Division, Soil Conservation Service, Milwaukee, Wisconsin, first presented this paper at the annual meeting of the American Society of Agronomy, Fort Collins, Colorado, August 25, 1948. Mr. Anderson is also the author of many other papers that relate to Wildlife Management in all its aspects.

Figure 1.—In the sparsely covered areas of the Southwest, stubble-mulch tillage prepares an erosion-resisting seedbed and leaves enough grain and cover on the surface to feed and protect game birds.

of ¼ mile or less; to big game species that range as far as a mile in the course of a day's search for food. Wildlife must find all of its food, cover, and water requirements within its daily cruising radius. Therefore, the quantity, quality, and distribution of food, cover, and water largely determine the land's carrying capacity for wildlife.

The amount of land suitable primarily for wildlife production is small when compared with the amount of land best used for cropland, pasture or range, or woodland. The best estimate indicates only about 100,000-000 acres in the United States (Graham, 1946). Most of this wildlife land occurs as small areas interspersed with land used for other purposes, on much of which agronomic practices are an important part of management. On many farms there are small eroded areas, unproductive field borders, and odd areas cut off from cropland by drainage ditches or streams which have a high nuisance value as far as the agronomist is concerned. Many of these areas will not return a crop that will compensate for the seed, fertilizer, and labor expended on them. Frequently it is possible to solve a difficult agronomic problem on small areas by changing the land use from cropland to wildlife land.

Because of this close interspersion of wildlife land with cropland, hayland, and pasture, and because wildlife is a secondary crop on land managed primarily through the use of agronomic practices, these practices are very important in wildlife production.

While wildlife benefits from the application and use of good agronomic practices, there is an increasing amount of evidence that certain kinds of wildlife play an important role in the successful application and use of many agronomic practices. Certainly it is true that a badly eroded, run-down, over-cropped farm has a higher population of the so-called "pest" forms of wildlife and a lower population of useful kinds of wildlife than is found on a farm that employs good crop rotations, uses needed soil conservation practices, and develops as wildlife land all areas for which that is the best use.

Soil Management and Wildlife

There are many examples of the relationships between wildlife and soils. Van Dersal (1937) concluded that animals contribute to soil mixing, aeration, drainage, and fertility; that they increase the soil's porosity, promote better plant growth, result in reducing soil erosion; and by combination of all these factors make a definite contribution to soil conservation. He also points out that trampling animals compact the surface soil, thereby increasing its tendency to erode. Hopp (1946) points out the value of earthworms in forming soil aggregates that resist the beating action of rain and flowing water, resulting in a soil that keeps its looseness whether wet or dry and one with high infiltration capacity. He further shows the relationship between earthworm populations and intensity of land use, indicating a correlation between low earthworm populations and continuous clean cultivation as contrasted with high earthworm populations and continuous sod cover.

Preliminary results reported by Haseman (1946) indicate that there is a relationship between soil mineral deficiencies and insect pests. His studies indicate, for example, that chinch bugs thrive and reproduce faster when fed on plants grown on soil deficient in nitrogen than they do when fed on plants grown on soil having a plentiful supply of nitrogen. Certainly that is a good argument, among others for crop rotations containing legumes in sufficient regularity to maintain proper nitrogen levels.

Crop rotations also are important in determining the populations of other kinds of wildlife, particularly ground-nesting species, that can exist on farm land. Dambach and Good (1940), working in Ohio, found that conventional fields of corn, small grain, and meadow supported the following numbers of pairs of breeding birds per 100 acres: corn, 3.23; small grain, 10.26; meadow, 47.90. Obviously, then, crop rotations with higher percentages of meadow in them will support higher populations of this kind of useful wildlife, which includes at least two important game species, bobwhite quail and ring-necked pheasants.

The data presented, although all too meager, point to the important relationships that exist between soil management and wildlife. Additional research on the part of biologists and entomologists will undoubtedly produce evidence of other, and possibly more important, relationships. The field is virtually unexplored.

Conservation Practices and Wildlife

Agronomic conservation practices have a direct bearing on wildlife populations. Dambach and Good (1940) found that strip cropping approximately doubled the number of pairs of breeding birds per 100 acres in Ohio when compared to the same crops grown in conventional fields. Similar results have been found by Edminster (1941) in the Northeast.

Bond (1948) states that California quail will not go more than a few feet from cover—they never feed in bare fields except on the extreme edges. He reports that when a field near Watsonville, California, was strip-cropped, the quail followed the tall vegetation in one set of strips and fed in the adjacent fallow strips, thus using half the field instead of just the edge of it. As a result, the resident quail population was approximately doubled.

Strip cropping has not found favor as a conservation

Figure 2.—A permanent border of bicolor lespedeza (left) and sericea lespedeza (right) converts poor cropland into productive wildlife land in the Southeast.

Figure 3.—Poor range management results in plant and animal "weeds"—in this case, Canadian thistles and prairie dogs.

practice in areas such as Missouri and southern Illinois, where chinch bugs are a constant threat. However, modern strip cropping patterns, as developed by agronomists, (Gardner, 1941), which call for the alternation of small grain and legume strips in one field while corn and legume strips are alternated in another, should largely eliminate the possibility of severe chinch bug damage.

Borell (1948) reports that stubble-mulch tillage (Fig. 1) is probably the most important agronomic practice from the standpoint of wildlife in the Southwest. He points out that food and cover left on the surface of the soil benefits especially quail, pheasants, ducks, doves, and prairie chickens. He further states that grassed waterways provide escape cover, nesting cover, and travel lanes for pheasants, quail, prairie chickens, and, in a few locations in the Southwest, for sage hens. Grassed waterways have been observed to have similar wildlife values in the Midwest and other sections of the United States.

In the Midwest, particularly in Iowa, farmers who practice contour cultivation are finding that end-rows of corn up and down the sloping ends of their fields are too great an erosion hazard. As a result, many of them are establishing rod-wide headlands or turn rows of alfalfa and bromegrass. These headlands are seldom harvested for hay (the acreage is too small), frequently are not harvested at all, but in many cases are used as a seed production source for adapted strains of bromegrass. Such management is ideal from the wildlife standpoint, since the headlands are virtually undisturbed until well past the time when ground-nesting birds have brought off their broods. This practice is another example of good land management that benefits wildlife.

Permanent cover crops in orchards is another agronomic practice with wildlife implications. In the Michigan fruit district, this practice has not brought on any wildlife problems, but in California, according to Bond (1948), it resulted in higher populations of field mice and pocket gophers, which damaged the trees and interfered with irrigation. However, it was found that pocket gopher control was cheaper and less time-consuming than cultivation and that field mice could be controlled by the simple expedient of grazing the cover crop with sheep in the fall. The grazing exposed the field mice to predators and resulted in almost perfect control. Similar experiences with field mice have been observed in the Midwest in connection with new woodland plantations. An important biological problem in connection with the use of permanent cover crops in orchards, for which, to my knowledge, there is no data, is the matter of the effect of the permanent cover on the population of useful pollinating insects. Here may be another important wildlife relationship since it is logical to expect that the change from cultivation to sod cover would be very beneficial to many species of solitary bees.

Closely related to agronomic practices is the farm fence row—an area necessarily lost to cultivation and one which, under certain kinds of management, may be a continuing source of weed seeds to infest adjacent crop fields. Also, entomologists and farmers once suspected the fence row of being a dangerous source of insect infestation and consequent crop damage. Entomologists no longer hold this opinion, but many farmers do. Recent studies by Dambach (1945) indicate that shrubby fence rows harbor fewer injurious insects, more beneficial insects, fewer harmful small mammals, more useful small mammals, and more breeding birds than do grassy fence rows. These facts, coupled with the successful use of multiflora rose as a living fence (Fig. 2) in the Midwest and Northeast, indicate that fence rows may become important contributors to the successful application of many agronomic practices. As indicated by Steavenson (1946), living fences of multiflora rose never grow taller than 10 feet; thus they do not result in lowering yields of adjacent field crops as do fence rows containing Osage-orange hedge and other tall growing trees. They cast a dense shade; hence are effective in controlling weed infestations in the fence row. The wildlife they harbor may contribute significantly to legume pollination and the control of those species of insects and small mammals that result in crop damage.

Also closely related to agronomic practices are the techniques of field border management that originated in the Southeast and are now spreading to other parts of the country. Davison (1941) pioneered the use of permanent perennial vegetation to occupy the narrow strip of land between woodlands and crop fields (Fig. 3) that were largely unproductive of farm crops and frequently

Snowdrift Erosion in the Northwest

Snowdrift erosion reaches its fullest development and magnitude in the Palouse region of the Pacific Northwest. It is most common in the area lying between Spokane, Washington, on the north and Lewiston, Idaho, on the south. It is most extensive in Washington, less so in Idaho.

It is not common in any other section of the United States and is unknown in most parts of the country. Snowdrift erosion is the combined result of sand-dune-like topography, heavy winter snowfall, strong southwest winds, slow rate of melting on north slopes, and common prevailing cloudiness.

The following pictorial story by W. A. Rockie of the Soil Conservation Service presents a bird's-eye view of the Palouse region and its rather spectacular snowdrift erosion.

An aerial view of the heart of the Palouse region looking west from Moscow, Idaho, and looking at Pullman, Washington, nine miles distant in the upper center. Part of the University of Idaho Campus shows in the immediate foreground and the State College of Washington is on the near side of Pullman. The lower half of the picture is in Idaho, the upper portion in Washington. Every snowdrift marks the upper rim of a leeward steep north-facing cove.

Left. This view of the snow-covered Palouse area is
south from Steptoe Butte into these north-facing co
larger coves are in deep shadows, the smaller ones wit
tense shadows. Winds usually bare most of the land. T
covered landscape is rather unusual.

Left. However, if one turns to the left, and looks to
he finds that the south sides of the Palouse hills are m
bare than the north facing slopes indicate.

As the drift shrinks to nothing, the concentrated erosio
from the earlier large drift is exposed. The upper li
erosion rills mark the lower line of the original dr

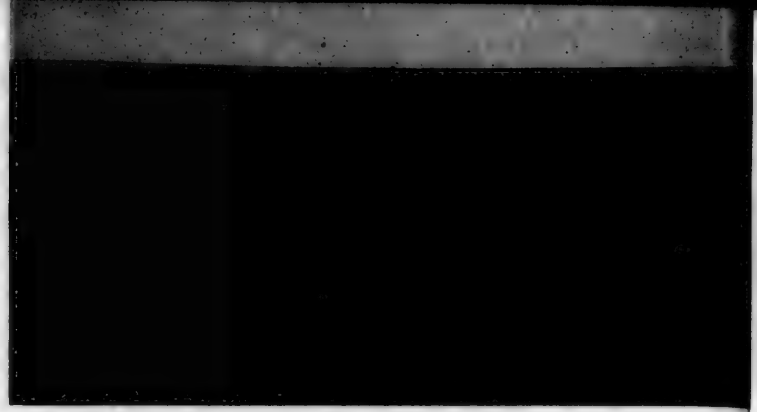
Right. These steep north slopes accumulate great amounts of snow, occasionally reaching vertical depths of 25 to 30 feet. A single heavy fall of snow may, after a few hours of strong winds, find itself moved almost entirely into 10-20 foot drifts covering only 3 to 5 percent of the land area.

These drifts assume highly grotesque shapes. No two are alike because on no two hills are the topography and air currents alike. This view is looking down into one of the smaller north-facing coves. The contour tillage pattern as fitted to each individual cultivated cove is clearly evident. Although the surface gradient in many of these coves reaches 50 percent, most of them are in cultivation.

Some of these coves extend for a half mile in a general east-west direction, although most of them are much shorter. During the past 15 years many of these coves have been planted to trees, grass or alfalfa in an effort to curb disastrous snowdrift erosion.

Below. Occasionally heavy rains cause erosion and runoff from the hilltops above the drifts. This black muddy runoff runs onto the white drifts, the water is absorbed into the snow and a lacy pattern of soil is left in picturesque fashion upon the surface of the drift.

Bottom Right. Sometimes erosion from rains occurs after the snowdrift is entirely melted. The position of the former drift is marked by the shaded strip along the brow of the hill.



Top. Snowdrift erosion makes these north slopes very late for farming. The land above the drift's position can be farmed long before the soggy slope underneath and immediately down from the drift. Farming farther down the slope also gets under way long before the steep north slope can be farmed.

Center. Occasionally a second series of drifts comes after the first couple of drifts has come and gone. Slightly different wind direction may place the succeeding drift lower on the coves than its predecessor so that the new drift may cut across and cover the erosion rills which resulted from the earlier one much farther up the slope. As in the preceding picture, farming is encroaching on this late-season drift both from above and below.

Bottom. Occasionally, the excessive saturation of the land by a snowdrift may cause both the heavy rilling seen in preceding picture and in addition many soil slips which also start at the lower edge of the snowdrift.

presented serious erosion problems. Thus, what had been an agronomic problem was solved by converting poor cropland into good wildlife land that now produces bobwhite quail in abundance. *Lespedeza sericea* was the first plant used for this purpose. It was suitable from the land management standpoint but was not as valuable as it might have been for quail. Continued work resulted in the present use of *lespedeza bicolor* for this important practice. Using the latter species, Davison (1948) reports that ⅛ acre of bicolor is sufficient to carry a covey of quail through the winter in the Southeast. He further states that it has been possible, through the use of wildlife borders of *lespedeza bicolor,* to establish and maintain as many as five coveys of quail per 100 acres of farm land. Here is an example of the fact that wildlife can be, on certain types of land, a crop that will provide the landowner a greater return than could be expected if the same land were used to try to produce so-called regular farm crops.

Pasture renovation through the introduction of dry-weather legumes illustrates another relationship between agronomic practices and wildlife. Graber (1936) reports that a pasture in southern Wisconsin, renovated 6 years earlier with white-blossom sweetclover, had a white grub (larva of the June beetle), population of 22,000 per acre while an adjacent unrenovated bluegrass pasture supported a population of 108,000 per acre.

Proper grazing of pasture land has its wildlife relationships, too. Working in northwest Iowa, Bennett (1937) found that overgrazed pasture contained no duck nests, ungrazed pasture supported one duck nest per 11 acres, while moderately grazed pasture (one cow per 5 acres) supported one duck nest per 10 acres. The same study showed that badgers and skunks increased abnormally on ungrazed pasture to the apparent detriment of nesting ducks. He concluded that grazing one cow per 6 acres would be beneficial to nesting ducks.

Supplying water for livestock is another conservation practice closely allied to the agronomic practice of pasture improvement and management. Frequently it is the factor that decides whether or not a given parcel of land can be used for pasture. The construction of farm ponds is the most common way of supplying livestock with the needed water—and in the process, a valuable wildlife habitat is formed with little extra cost. It is a habitat capable of producing as many pounds of meat per acre in the form of fish as the area occupied by the pond could produce as beef if it were used for pasture. In addition, by fencing and planting a small area surrounding the pond with adapted grasses and shrubs, the pond can become an important producer of quail, rabbits, and other forms of upland wildlife. Greenwell (1948) reported that well-developed farm ponds in southwest Missouri carried quail populations as high as eight birds per acre of fenced area during a prolonged drouth period. Thus it becomes apparent that ponds are just as useful for wildlife as they are for livestock, particularly during dry weather.

Wild Pollinators for Legume Seed Production

There has been a good deal of emphasis in recent years on the need for insects to pollinate legumes if adequate

Figure 4.—Grazing of range and pasture lands in accordance with their carrying capacities reduces range wildlife problems and increases the land's productiveness for useful wildlife.

seed production is to be obtained. Since legume plays such an important role in soil management and conservation, it is essential that legume seeds be available in sufficient quantities and at reasonable prices. Much has been said about the value of honeybees as legume pollinators, and there can be no doubt that they are extremely valuable and that they are more easily controlled and managed than wild pollinating insects. On the other hand, according to the Bureau of Entomology and Plant Quarantine (1946), "it is essential . . . to conserve our native pollinating insects, since some species of native bees are more efficient, bee for bee, than honeybees and will work under more adverse conditions."

Furthermore, the encouragement of wild bee populations does not appear to be hopeless; in fact, it appears that some of the land management practices we have been discussing may be of considerable value in this respect. Linsley and MacSwain (1947) suggest the following methods: the production of seed in the same vicinity year after year; a minimum of summer irrigation; allowing uncultivated strips to remain near the field; the preparation of fence posts, logs, dead trees, etc., for nest sites; and the planting of rose bushes and certain other plants in the vicinity to provide suitable nest materials for megachilids. These suggestions indicate that wildlife borders of *lespedeza bicolor* or legume-grass combinations and living fences of multiflora rose would be very helpful in conserving and increasing populations of wild pollinating insects.

Range Management and Wildlife

The management of range wildlife is a controversial subject, but there is increasing evidence in the literature that it is basically a problem of the management of land and a problem in which agronomists and range managers will have no little part to play. The chief problems of wildlife in relation to range management center around rodents, predators, and big game. So far as rodents are concerned, most of the evidence as summarized by Bond (1945) points to the fact that they are animal weeds—increases in their populations follow overgrazing and land misuse just as surely and in much the same manner as does the invasion of the range by annual weeds. (Fig. 4) As for predators, recent research (Murie, 1940) indicates that rodents constitute no less than 65 percent of the diet of coyotes, a fact which substantiates Vorhies' (1937) suggestion that if less predator control were practiced, less rodent control would be necessary. Big game undoubtedly compete with livestock for forage to a degree, but here again, recent research points to the fact that, for many species at least, there is no direct continuous competition. Stoddart and Rasmussen (1945), for example, found that mule deer in Utah need brush and shrubs in their diet, while cattle and sheep must have grasses. They found that cattle graze about 75 percent of the area grazed by deer, while sheep graze about 87 percent of the deer range. On the other hand, cattle eat only about 25 percent and sheep only about 50 percent of the plants eaten by deer.

Another interesting range-wildlife relationship is the one between jackrabbits and juniper (Anonymous, 1948). A study by Wolff in Texas showed that jackrabbits are important seed carriers for juniper and that they are responsible for part of its spread. The study points out, however, that "it is only since heavy use of range has lowered stamina and abundance of the climax grasses that the cedars have been able to sprout and compete successfully for available plant growth elements."

All of the evidence cited points to the conclusion that many of the range-wildlife problems will be made less trying, if not entirely solved, by good land management, including grazing within the carrying capacity of the range and reseeding to increase its carrying capacity.

Modification of Agronomic Practices for Wildlife

The direct application of many agronomic practices will be of real value to wildlife and to a resultant better biologic balance of farm and ranch lands. In addition, there are a few modifications of agronomic practices that will result in additional benefits, not only for wildlife but for the conservation of soil as well. *Time of plowing* is very important. Fall plowing is poor erosion control, and it is poor wildlife management. Leaving crop residues on the surface over winter, followed by spring plowing, helps to control erosion and definitely aids wildlife by providing food and cover.

Time of mowing is also important. Meadow crops, of course, must be mowed when their protein content is at its peak, but grassed waterways, headlands, ditch banks, and pastures can be mowed later in the season. Delaying the mowing of such areas until after the time of grain harvest will permit many ground-nesting birds to bring off their broods successfully. Mowing is one of the highest mortality factors for ground-nesting species.

It has been possible only to hit the highlights in this discussion of agronomic practices in relation to wildlife. That those relationships are important from the standpoint of the whole picture of natural resource conservation was well expressed by Graham (1946) when he wrote, "We want wildlife in America because it affords recreation to millions of people, because it provides a very substantial economic return to a great many others, and above all, perhaps, because it is a valuable heritage and an expression of a national house in good order."

(*Continued on page* 128)

Efficient Use of Farm Manure for Erosion Control

GEORGE R. FREE

IT IS IMPORTANT that efficient use be made of farm manure for crop production and for maintenance and possible improvement of soil fertility and productivity. It has been estimated by Gustafson (1) that the amount of farm manure produced each year in and around the farm buildings of New York State is at least 20 million tons. He emphasizes the fertilizing value of this product by stating that the 20 million tons contains in its fresh, unrotted condition seven times as much nitrogen and potash and approximately the same quantity of phosphoric acid as all of the 455,665 tons of commercial fertilizer used in the State in 1942.

Efficiency in the return of these nutrients to the soil and crop, the beneficial effects on tilth, and the protection afforded the soil and crop when manure is used as a top dressing or mulch are the factors usually emphasized in recommending methods of handling and using farm manure.

Description of Experiment

An experiment was started at Marcellus, New York, in 1943 to determine the effects of different rates and methods of applying manure on soil erosion and surface runoff. Runoff plots, 12 feet wide and 72.6 feet long, were installed on an area having a slope of 17 percent. The soil is Honeoye silt loam which is an important, productive soil of New York, developed from glacial till derived largely from limestone.

A 3-year rotation consisting of corn, canning peas, and clover was followed. Superphosphate was used with manure for corn, and a complete fertilizer with manure for peas.

On one set of plots manure was turned under in the spring at the rate of ten tons per acre for the 3-year rotation, and on another set at the rate of 20 tons per acre. The same amounts of manure were used on a third and fourth set of plots, but there the manure was applied as a top dressing immediately after planting. The applications in all cases were split with part being used for corn and part for peas.

The following table shows the results from this experiment over a 4½-year period:

Comparative results with turned-under and top-dressed manure, Marcellus, New York.

Manure	Total surface runoff[1]	Total erosion losses	Gain in percentage organic matter in surface soil	Relative total crop yields
	Inches	*Tons/acre*	*Percent*	
Turned under:				
Low rate	27.4	31.1	0.35	100
High rate	26.4	19.5	.52	95
Top dressed:				
Low rate	19.5	11.0	.54	101
High rate	17.5	4.5	.64	106

[1]Total precipitation for the 4½-year period was 163.5 inches.

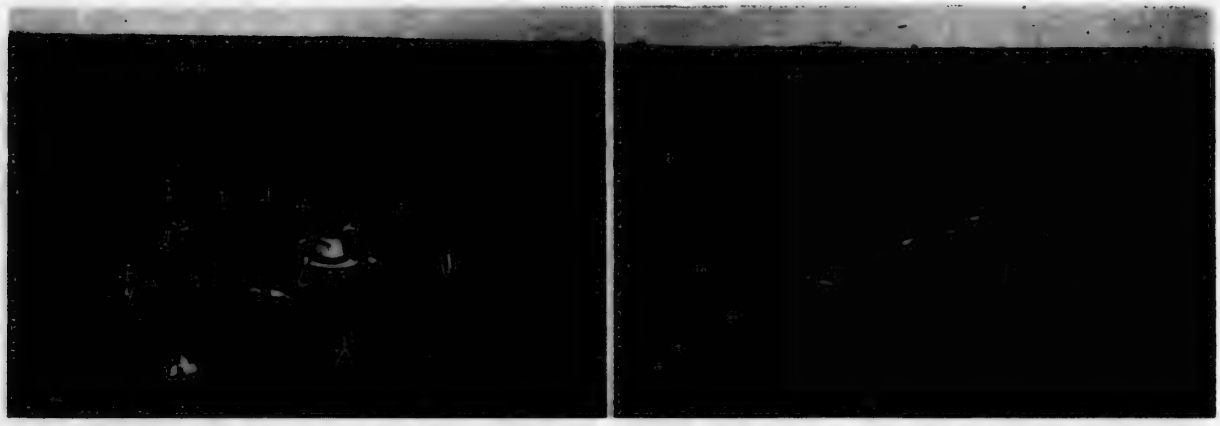
The plots with the low-rate application of manure turned under lost nearly 17 percent of the precipitation as runoff and more than 31 tons of soil per acre by erosion in a period of 4½ years. There was considerable variation in seasonal and annual losses depending upon cover, soil conditions, and differences in the amount, intensity, and character of precipitation. This particular set of plots had the benefit of a rotation which included a year of clover hay, the use of manure and commercial fertilizer, and contour planting of row crop. In effect, they have also had the protection given by strip cropping and diversion terraces since the plots are only 72.6 feet long and are protected from outside water by metal boundaries. One can speculate regarding the effect the omission of any one of these good management practices would have had in increasing losses.

Top Dressing Reduced Losses

Doubling the amount of manure plowed under had only a slight effect on runoff but did decrease erosion by about one-third. Using the same quantities of manure as top dressings gave marked reductions of both runoff and erosion. In fact, the low-rate application as a top-dressing was considerably more effective in reducing losses than the high-rate application plowed under.

A study of the detailed records from this experiment shows that the greatest benefit from top dressing comes during the growing season. This is to be expected, but it is worthy of considerable emphasis. The time from

This paper by George R. Free is a contribution from the Division of Research, Soil Conservation Service, U.S.D.A., in cooperation with Cornell University Agricultural Experiment Station. Mr. Free is a soil conservationist with the Soil Conservation Service with headquarters at Ithaca, New York. The author wishes to acknowledge the help of John Lamb, Jr., and others in this study. Organic matter in soil samples from experimental plots was determined by E. A. Carleton.



Erosion as discussed in this experiment at Marcellus, New York, where the plots were less than 75 feet long is not spectacular. The view on the left shows the appearance of the soil in the spring under corn stubble on a plot 72.6 feet long. The rill by the hat is about four inches wide and one inch deep. The view on the right shows what happened when the length of plot was 210 feet. The hat is in a miniature gully 15 inches wide and four inches deep. These photographs were taken on the same day from points near the troughs at the base of the plots. These troughs serve to concentrate the runoff into a single stream and direct it into tanks where soil and water losses are measured.

the date of planting until the crop furnishes appreciable canopy protection and is drawing heavily on soil moisture is a period of considerable hazard in any cropping system on sloping, erodible soils.

The detailed records show also that the effect of top dressing persisted long after the manure had been mixed with the soil during cultivation. This is a particularly interesting finding and one that needs further study.

There was an appreciable increase in organic matter in the surface soil under all treatments. The increase was least for the treatment which permitted the greatest loss of soil. The method of using a given quantity of manure and the effect of this on erosion has been more important than the amount used.

Crop Yields Were Not Depressed

From the standpoint of crop yields, there have thus far been no significant effects of treatments. In any one year, it could be expected that the treatment which conserves the most nutrients and moisture should result in greater crop production if either or both tend to be limiting factors at any time. From the long-time standpoint, excessive loss of surface soil could be expected to result in lower yields.

The most important point to note regarding the yield data is that yields have not been depressed by using manure as a top dressing instead of plowing it under. Older studies, as reviewed by Salter and Schollenberger (2) show that the greatest value of manure for such crops as corn and grain is realized by quick incorporation or mixing with the soil. However, from the long-time standpoint, where erosion is an important factor, there may be insufficient justification for following a practice which may result in maximum conservation of fertilizing elements in the manure, but at the same time may permit less than maximum conservation of soil and water, and less than maximum conservation of the nutrients in each of these. It is not known whether runoff was a factor of any great importance in the older work.

The difference between top dressing and the practice of using crop-residue or stubble-mulch tillage needs emphasis. With the former, the soil is loosened and prepared by plowing and subsequent fitting operations performed in the conventional manner. Similar benefits from the standpoint of soil and water conservation might and probably would result from tillage methods which leave organic residues on the surface; but, in the northern, humid areas, these methods of seedbed preparation have not as yet been fully satisfactory in most cases from the standpoint of yields.

Practical Difficulties of Top Dressing Recognized

The results of this experiment indicate clearly the great effect that top dressing has on erosion and runoff. The practice of winter top dressing of fall-plowed land with manure has not been evaluated in this study. This practice also should effect runoff and erosion, but probably to a lesser degree than the top-dressing practice studied. It is realized, of course, that there are some practical difficulties associated with the use of manure as a top dressing after planting. These, however, do not affect the validity and importance of the findings in this study. With conventional practices the rotation followed in this experiment could not be considered safe. A longer rotation with more hay would be recommended, but the results of this study indicate that top dressing

(*Continued on page* 124)

Improvement of Italian Mountain Pastures

W. T. WHITE

TECHNICAL ASSISTANCE PROVIDED under the World Food and Agriculture Program, to enable war torn European Nations to re-establish their industrial and agricultural production schedules included a project for the study and improvement of mountain pasture lands in Italy.

This project was ably planned and developed by the Italian Forestry Corps, a branch of the Italian Ministry of Agriculture. The program provided for the survey, planning and development of pasture improvement practices under the leadership of an experienced American range specialist. The program was limited to those specific grazing units lying within the mountain area administered by the Forestry Corps. It also provided for the development of a small research program, to produce needed grass and legume seed adapted to mountain conditions, and for the testing of new grazing practices.

Italian mountain grazing lands are held in three principal ownerships: by rural Communes, by individuals and as State owned pastures administered by the Forestry Corps.

The mountain pastures are an exceedingly important link in the Italian economy and food supply. Much of the fattening of livestock, and production of cheese is directly off of grass. The mountain pastures are the summer feeding grounds for practically all of the sheep, and for many of the milk cows, as well as for the growing of young animals, and for grazing considerable numbers of work cattle during the late summer and fall. In addition most of the mountain pastures are so situated that they are a primary influence upon water supplies, for domestic consumption in cities and towns, for irrigation and of lower lying farm lands, for industrial hydro-electrical power and for flood control.

Population Pressure on Land is Great

Italy with a population in excess of 45,000,000 consists of a boot-shaped peninsula, and the two islands of Sicily and Sardinia, with a total area about that of California. The population pressure for land is so great that, not only are all of the available lower lying agricultural lands intensely cultivated, but the cultivation of land has been pushed high on the steep mountain sides and into short-season high mountain basins and valley lands, where the cultivation is a hazard to the soil and the production of economic crops is very uncertain. The shortness of season does not allow for the natural maturity on most cultivated crops in seasons of normal length. Grain and other crops have to be harvested before maturity and alternately dried on clear days and stored on stormy or rainy days. Under these circumstances lands are being cropped principally to cereal grains—where it is economically impossible to prevent or control erosion, and where the expected average crop return is not only very low but also extremely uncertain from year to year because of frosts, drying winds and other vagaries of the "short season" weather.

Not only are the mountain basin and valley lands and mountain slopes under these conditions of intensive cul-

Figure 1.—Communal settlement of some 1,200 people dating back to feudal times. The village is a one-street town originally built on a sharp ridge for security purposes. The entire income of the village is from grazing and farming of small terraced fields on the mountain slopes. Barns and stalls for stock can be seen on edge of meadow.

Mr. W. T. White recently returned from Italy where he spent twelve months on an assignment with F.A.O. of the United Nations. He went there at the request of the Italian Government to help organize a conservation school for Italian technicians; also to make a study of a survey of Italian mountain grazing lands and to work with Ministry officials on a broad pasture conservation and improvement program. Mr. White is Regional Chief of the Range Division of the Soil Conservation Service, Portland, Oregon.

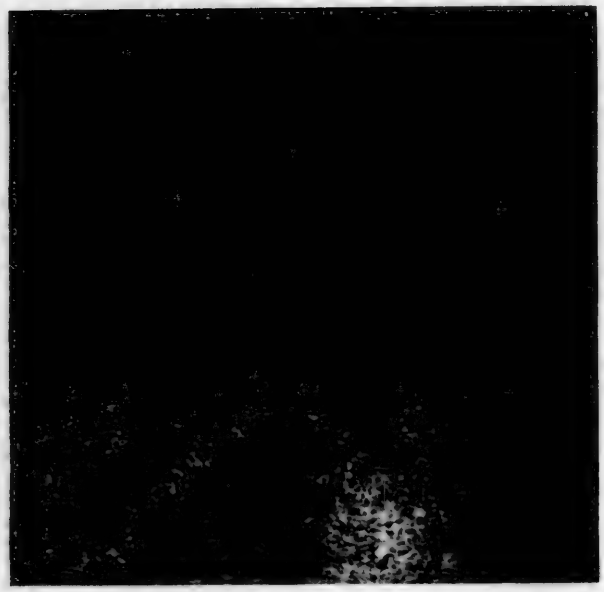


Figure 2.—This mountain basin pasture was once fertile and produced excellent stands of forage. The pasture is classified as a dry meadow type. Long continued abuse and overgrazing have allowed wind and water erosion to remove 10-14 inches of top soil. There is still 8-15 inches of soil overlying a gravelly subsoil. Although many small stones and rocks have accumulated on the surface, plowing and reseeding to adapted dry land pasture species and good management would allow the basin to again produce good forage although less than it originally produced. The soil is loamy, and the subsoil is gravelly silty clay. Abruzzo Province, Central Appenines.

tivation and overgrazing, suffering severely from erosion, but irreparable injury is being done to lower lying farm lands, to reservoirs, to stream channels, to navigation and to harbor installations at the mouths of the rivers leading from the eroding watersheds.

Combined with this extended production of cereals and other farming practices to areas not suited to cultivation which destroy the soils on mountain lands, is the pressure for more pasture and more livestock feed, to produce meat and dairy products. Improvement of Italian mountain pastures, therefore, has three major objectives:

1. Conversion to permanent pastures of mountain lands, now being farmed but unsuited to cultivation;
2. the development of maximum yields of forage palatable to livestock on each pasture unit;
3. the stabilization of the mountain pasture soils by the maintenance of adequate vegetal cover and plant residues to eliminate excessive runoff of rain and snow melt and loss of top soil.

Pastures Require Treatment

These highland pastures are located principally in the Alpine mountains north of the Po valley, and in the hook-shaped Appenines which form the backbone of the peninsula south of the Po. In addition a few good high land pastures also occur in the Sila mountains of the foot of the peninsula and some on the island of Sardinia. Range and permanent pastures occupy 53 percent of the entire agricultural and forest area, while croplands and orchards occupy seven percent. About two thirds of these pastures of the entire area are mountain pastures at elevations in excess of 3,600 feet.

Inspection and study of some 40 mountain pastures (locally called "Alpe," "Malga" or "Fondo," depending on the Region) reveals that moderate to serious erosion is occurring on part or the whole of 32, that 85 percent of the pastures were yielding less than one half the palatable forage they are capable of producing; that important improvements could be made in forage production by the adoption of good grazing practices and the construction of simple physical improvements, such as strategically located livestock water supplies, movable night corralls, drift fences and the removal of brush and weeds which have invaded certain areas.

In certain critical areas full forage yield would require, in addition, the application of lime and commercial fertilizers and reseeding.

Range condition surveys on the mountain pastures show that less than ten percent of the pastures could be classed as being in good or excellent condition, 30 per-

Figure 3.—Excellent condition mountain pasture elevation 1,200 meters. Grasses and legumes, containing practically no weeds or brush produce forage for both work and milk cattle. The pasture located in the Sila mountains of Southern Italy has probably been grazed since the pre-Christian era. Monuments and bas-reliefs in nearby ancient Greek settlements of pre-Roman times, picture large fat cattle, sheep and hogs.

cent as fair, and 60 percent as poor or very poor condition, where the classification was based on potential production as revealed by studies of the soil, forage composition, and amount of surficial organic residues.

Of special interest to the stockmen, and range specialists in the United States, is the fact that these mountain pastures have been grazed for hundreds of years, some of them since before Julius Caesar's time and still can be classed as good or excellent condition pastures.

Existing Conditions Make Improvement Program Difficult

Range surveys and planning of specific mountain pastures show that, technically, improvement is a relatively simple matter, but that public attitude, understanding of livestockmen, land owners and administrative officials of the problems involved, lack of governmental machinery for carrying proven facts to the public, lack of demonstrated results and mistrust of Government directed projects by rural people make the rapid and widespread application of an effective mountain pasture improvement program exceedingly difficult.

However, a number of mountain pastures have been surveyed and planned, in cooperation with the owners of the pastures.

The more important problems found to be involved were:

1. Too early grazing in the Spring.
2. Grazing too closely and too late in the Fall.
3. Invasion of aggressive brush and weed species, due to continued overgrazing.
4. Excessive trailing and travel over pasture, because of inadequately spaced water supplies and improper use of bed grounds.
5. Active sheet and gully erosion.

Remedial measures and practices in the pasture improvement plans, have included:

1. Adoption of a season of grazing use based on the stage of forage growth and need for the accumulation of plant residues, on the surface of the land.
2. Removal of noxious weeds and brush.
3. Division of pastures into units for deferred or rotational grazing.
4. Development of stock water supplies to eliminate excessive travel over pastures.
5. Plans for night herding, rather than corralling stock at night, or moving to new bed grounds at short intervals.
6. Control of erosion and excessive runoff (a) by maintaining more top growth of forage plants and by the gradual accumulation of plant residues on the surface of the ground; (b) seeding and planting to vegetation and the temporary elimination of grazing drainage ways and stock trails.
7. Reseeding adapted species on the deeper soils where pastures have been invaded by weed and brush species.
8. Improved distribution of livestock to secure better distribution of grazing use and of manures, and the application of lime and commercial fertilizers to areas of depleted fertility.
9. Drainage of swampy areas.
10. Supplemental irrigation on certain suitable sites.

Figure 4.—Destruction of valuable valley bottoms growing and orchards is a common sight in Italy. The major causes lie in the higher watersheds where eroding pastures, forest land, and the rapid deterioration of cultivated hillsides and steep valleys, results in rapid runoff that carry tremendous loads of silt and sand. Not only are low lying valleys scoured of their top soil but deposits many feet thick are left in the channels and on adjacent farm lands.

Recent Research Reviews

JAMES H. STALLINGS

The Reviews by J. H. Stallings that follow are a regular feature in the JOURNAL. It is hoped that the projects reviewed from time to time will be helpful to conservationists everywhere. Members of the Society are urged to indicate their interest in the kind of research work that should be reviewed.

Stubble Mulch Tillage. *By* M. P. HANSMEIER, T. S. AASHEIM *and* A. H. POST. *Mont. Agr. Exp. Sta. Cir. No. 203, December 1948.*

Fallow protected by crop residues on the surface has shown much more resistance to both wind and water erosion than black fallow. Yields on both types of fallow have shown no appreciable difference. Wheat grown in stubble mulch in Hill County averaged 20.0 bushels per acre over a 5-year period compared with a yield of 19.1 bushels per acre for moldboard plowing. Correcponding yields over a 6-year period in Roosevelt County were 28.4 bushels for stubble mulch and 29.2 bushels for moldboard plowed.

Stubble Mulch Farming New Hope for Eroded Soils. *By* F. L. DULEY *and* J. C. RUSSELL. *What's New in Crops and Soils, Vol. 1, No. 5, pp. 18-19, February 1949, 1910 Monroe Street, Madison 5, Wisconsin.*

Further erosion must be prevented and ample plant food must be supplied to produce abundant crops if badly eroded soils are to be reclaimed. The proper use of stubble mulch is effective in checking erosion and also produces conditions favorable to the establishment of permanent covers. Sweet clover seeded through the residue of the preceding crop supplies nitrogen to the soil and produces an excellent stubble mulch for the establishment of grasses. The sweet clover residue, if left on the surface of the ground, protects the soil while a grass crop is getting started. Since the sweet clover land provides a good supply of nitrogen, the grass crop starts off rapidly and soon gives effective ground cover to protect the soil against further erosion.

When used this way sweet clover protects the soil against erosion while growing, and, when left on the surface by the stubble mulch system, the residue gives protection while the grass crop is getting started.

Rates of Runoff for the Design of Conservation Structures in the Upper Mississippi Valley Upland Loessial Areas. *By* N. E. MINSHALL. *USDA-SCS-TP-73, Washington 25, D. C., January 1949.*

This publication is one of a series containing information for the hydrologic design of conservation structures and practices in important agricultural areas where hydrologic studies have been made by the Soil Conservation Service. The information and procedures contained in the publications are based on rainfall, runoff, and other hydrologic data obtained from runoff studies and from other research projects.

Records of runoff from small watersheds, within the areas included in this publication, are still very limited as to range in watershed size and length of record. More definite information is needed on the relation of rates of runoff to size of drainage area and the effect of crop cover on rates and amounts of runoff from watersheds of various sizes. Rates of runoff from individual terraces of various lengths and horizontal spacings and under several crop covers and rotations are necessary before recommendations can be made for terraced areas. Pending additional research, such data as are now available must be utilized to fill the present-day needs. Values presented in this report must be considered tentative, however, and subject to revision as additional information becomes available.

Infiltration, Soil Moisture, and Land-Use Relationships with Reference to Surface Runoff. *By* LEONARD SCHIFF *and* F. R. DREIBELBIS. *Amer. Geophysical Union Trans., Vol. 30, No. 1, pp. 75-88, February 1949.*

The major development in this paper is a method for determining rates of water movement within the soil profile on watersheds under natural conditions. The method uses rainfall rates or infiltration curves as the supply of water to the soil and field measurements of soil-moisture changes. The major objective was the determination of relationships between infiltration, soil moisture, and surface runoff on watersheds representing two soil types of different hydrologic characteristics and in three vegetal covers. Information was developed on the effect of soil properties and land use upon such relationships.

Protecting the Land Against the Raindrop's Blast. *By* W. D. ELLISON. *The Scientific Monthly, Vol. 68, No. 4, pp. 241-251, April 1949.*

Each falling raindrop that strikes the ground acts as a miniature bomb and splashes soil into the air at its point of impact. Violent rainstorms have great capacity to splash the soil and to damage the land by this "blasting" action. Different soils are destroyed in different ways, and at different rates, by the impact and splash

of falling raindrops. The amount of vegetal cover protection needed to conserve the soil varies with the differences in rainfall and soil characteristics.

Differences in drop impacts, from one storm to another, may cause the soil splash on a bare field to vary from less than 1 to more than 100 tons per acre. Differences in soil characteristics may vary the splash by more than 450 per cent, and the differences in the protective values of vegetal cover may cause the soil splash to vary more than 10,000 per cent.

Soil splash by raindrop impact represents the very beginning of erosion on land surfaces outside the gullies and channels. Raindrop splash accelerates the loss of topsoil over the entire surface of a field. The splash process sets top soil in motion and also places it in suspension in the surface water. It puddles surface soil and causes surface seals to be formed. It also separates the organic matter and small mineral particles from the soil mass and enables them to be floated away.

Cause-and-effect relationships in erosional damage can be determined by measuring the differences in the splash factors of drop impact, soil capacity to withstand such impact, and the protective value of the vegetal cover. The technique and equipment used are described.

A Study of the Movement of Surface Wind. *By* AUSTIN W. ZINGG. *Agr. Eng., Vol. 30, No. 1, pp. 11-13 and 19, January 1949.*

The purpose of this study was to develop and present methods of approach to the analysis of records of wind movement with a view of obtaining a better understanding of the characteristics of the natural force encountered in soil erosion by wind. Records of wind movement obtained at Dodge City, Kansas, during a 74-year period were used for the purpose. Certain adjustments in these data were made in an attempt to make them representative of the present location of the gage. Adjusted monthly averages of wind velocity were found to be amenable to study by probability methods.

Wind intensity-duration curves were developed for wind movement occurring during the month of April for selected years. The general pattern of these curves was found to be similar.

An average dimensionless pattern of windstorms was derived from storms occurring during the month of April, 1935. The peak of storm intensibility was found to be at the midpoint of storm duration.

The results of the study indicate that the problem of soil erosion by wind may be approached analytically by methods similar to those employed in the fields of hydrology and flood control.

Wind Erosion Control with Shelterbelts in North China. *By* W. S. CHEPIL. *Agron. Journal, Vol. 41, No. 3, pp. 127-129, March 1949.*

In some regions of North China shelterbelts have been used for many generations to protect very sandy land from erosion by wind. The method consists of growing trees or bushes in single rows 20 to 60 feet apart in one direction and 100 to 500 feet or more apart at right angles to this general direction. The whole landscape is thus divided into small rectangular fields protected by shelterbelts on all four sides.

Extensive areas of bare, wind-swept sands created by the flood waters of the Yellow River during the recent war years presented a great problem for the destitute population. UNRRA and the Chinese Government carried out a program of planting willow shelterbelts in accordance with the established local practice in order to reclaim such lands for agricultural use.

Crop Yields Lowered By Erosion. *By* R E. UHLAND. *USDA-SCS-TP-75, February, 1949.*

The data presented herein show that crop yields decline steadily as the depth of topsoil is reduced by erosion. Since soil and water conservation practices can be expected to compensate but partially for the loss of topsoil and organic matter that occurs under non-conservation farming, emphasis must be placed on the urgent need for the adoption of a conservation type of farming while a good amount of topsoil and organic matter remain.

Farmers who have selected their crops wisely and who have been careful in planning their cultural operations find more topsoil remaining on their fields than on their neighbors' fields which have been managed with less care. These same farmers who have managed their land so as to retain most of the original topsoil have, and will continue to have, much higher crop yields. The study shows that crop yields begin to decline with the loss of the first inch of topsoil. This will be news to those who feel that erosion does not affect yields until the sub-soil is exposed.

Essential Characteristics of Durable Concrete Draintile for Acid Soils. *By* DALTON G. MILLER *and* PHILIP W. MASON. *Agr. Eng., Vol. 29, No. 10, pp. 437-441, October 1948.*

This paper is based on examinations and tests of some 1100 commercial and experimental draintile and 10,000 2 x 4-inch experimental clyinders. Installations were made in three peats in Minnesota, three peats in Wisconsin and an acid mineral soil in North Carolina. Practically all concrete and mortar specimens so far examined have shown some evidence of corrosive action where the exposure periods in peat have been around 20 years. In general, the degree of corrosion has varied with the acidity of the peat and the unit strength of the test piece, whether draintile or cylinders. It is therefore the best

practice to lay concrete draintile of the smaller sizes, as ordinarily made, in the more acid peats. On the other hand, well-made concrete draintile should give reasonably satisfactory service for many years when laid in the low acid grass and sedge peats that favorably respond to cultivation without much liming.

A Simplified Technique for Determining Herbage Production on Range and Pasture Land. *By* N. C. FRISCHKNECHT *and* A. P. PLUMMER. *Agronomy Journal, Vol. 41, No. 2, pp. 63-65, February 1949.*

A procedure for measuring herbage production has been developed and used for the past 10 years with satisfaction. It is essentially an adaptation of the weight-estimate method, but can be used to advantage in conjunction with any of the range survey methods mentioned in establishing forage yields for range types. It permits a direct estimate of green herbage yield in pounds per acre in the field. This is made possible by regulating the size of plots used, so that grams per plot convert directly into pounds per acre. By estimating weight of forage, checked by clipping and weighing vegetation for these plots, a person can soon learn to estimate pounds of green herbage per acre directly.

The procedure is based on the fact that the weight of herbage produced in pounds per acre is equivalent to the grams of herbage produced on a 96 square foot plot. However, it is difficult and impractical to estimate weight of vegetation on a plot so large. A plot one-tenth as large, containing 9.6 square feet, has proved very satisfactory for learning to estimate herbage production directly in pounds per acre on most range types. A cipher (0) must be appended to the grams of herbage on this plot to give "pounds per acre." It takes only a short time to clip, segregate, and weigh vegetation from plots of this size, and with but little such practice one can learn to estimate yield with reasonable accuracy.

A wire hoop 42 inches in diameter contains 9.6 square feet. Number 9 wire serves well for the hoop. Cross-wires give the hoop added support and may be of help to the estimator. The hoop can be easily carried in the field. The only other equipment necessary is a pair of shears, spring balance gram scales, calibrated to 5 to 10 gram intervals, and a cloth bag for clipping and weighing the herbage as a check on the estimates.

Reservoir Sedimentation in Limestone Sinkhole Terrain. *By* GUNNAR M. BRUNE. *Agr. Eng., Vol. 30, No. 2, pp. 73-77, February 1949.*

The purpose of the study reported in this paper was (1) to determine the amount, character, and distribution of the sediment that is filling Spring Mill Lake, Mitchell, Indiana, at such an alarming rate; the source of this sediment; and possible remedial measures which might be employed to reduce the damage, and (2) to determine the rates of sediment production which might be expected in the Highland Rim physiographic province, in which this reservoir watershed lies.

Trichloroacetate (TCA) for Bermuda Grass and Johnson Grass Control. *By* W. C. ELDER. *Okla. Agr. Exp. Sta. Mimeo. Cir. M-180, March 1949.*

This circular reports two years' results from the use of Trichloroacetate on the control of Bermuda grass and Johnson grass. It also describes the use and value of TCA under Oklahoma conditions insofar as the limited information at hand permits.

The Need for Grassland Husbandry. *By* MAURICE E. HEATH. *Better Crops with Plant Food, Vol. 22, No. 8, pp. 14-16 and 46-48, October 1948.*

A major problem in the corn belt is that of soil loss and depletion, caused by the emphasis put on acres of row-crop production and concentrate feeding of livestock. These practices are traditional and interrelated. A sound national grassland philosophy must be developed before we can adequately practice grassland husbandry on individual farms that will result in a permanent highly productive agriculture.

Grassland husbandry takes into account soils-plants-animals and their interrelationships on individual farms. Sufficient acreages of adapted grass-legume combinations are provided, depending on soil needs. High quality productive forages are emphasized in livestock production, with concentrates supplementing rather than dominating the feeding practices. It is in direct contradiction to soil exploitation.

Relative Protection Offered by Two Different Grasses to Conservation Channels in Soils of Different Texture. *By* W. O. REE. *Okla. Agr. Exp. Sta. Bul. B-319, pp. 8-11, March 1948.*

One of the experiments conducted at the Stillwater Outdoor Hydraulic Laboratory is described. This experiment was made to determine the protection offered from the erosive action of flowing water by vegetation to conservation channels in soils of different texture. The soil textures employed were a silt loam, a sandy loam, and a fine sand. The grasses used were Bermuda grass and weeping lovegrass. Tentative recommended permissible velocities for use in channel design are presented.

Efficient Use of Farm Manure

(*Continued from page* 118)

may be an alternative method of reducing the erosion hazard. Manure used as a top dressing at the rate of ten tons per acre was considerably more effective in reducing losses than was 20 tons per acre turned under.

LITERATURE CITED

1. Gustafson, A. F. Farm Manure: Its Production, Management, and Use. N. Y. Agr'l. College (Cornell) Ext. Bul. 642. 1944.
2. Salter, Robert M., and Schollenberger, C. J. Farm Manure. U. S. Department of Agr. Yearbook: 445-461, 1938.

BOOK REVIEWS

WILDLIFE FOR AMERICA. *By* Edward H. Graham *and* William R. Van Dersal. *Oxford University Press. 1949. 110 pp. 70 halftones. $2.50.*

Graham and Van Dersal continue their series of notable books condensed to few pages. There is much needed information within the attractive jacket of Wildlife for America. The photographs constitute a gallery of rare appeal to eye and heart, and the narrative builds up our sympathetic understanding of the land and the creatures of the land.

If we would save our country's strength and beauty, we must first attempt to civilize man himself and show him how to be a worthy partner of his friends of woodland, sky, and valley. Man's own salvation must come from within, from his suppression of the killer instinct and the substitution of an intelligent sense of responsibility. Wildlife for America is one of the books we need if we are to win the moral and spiritual resurgence necessary to our destiny. It gives us again the important ecological story told by the top writing team in its field with classic simplicity, good taste, sincerity, and impressive factual weight. It is mature, panoramic, worthy of the thoughtful graybeard but still better for his grandchild and his grandchild's teacher.

—Wellington Brink, *Washington, D. C.*

FIELDBOOK OF NATURAL HISTORY. *By* E. Laurence Palmer. *McGraw-Hill Book Co., New York. 664 plus x pp. 1949. $7.00. (Textbook edition $5.00).*

This is the first comprehensive reference on the whole field of natural history to appear in several decades. It covers not only the plant and animal world but also the solar system and the mineral kingdom. It is organized according to taxonomic order, the plant and animal sections starting with the simplest forms and taking up in order those higher in the evolutionary scale. Representatives of every important group are included. Each species is illustrated with a drawing. Its scientific name as well as common name is given and its place in the biological scheme—division, phylum, class, order, and family. Following a description of the organism and where it is found, there is a surprising abundance of ecological information concerning its relationships to other organisms and its habitat. Considerable emphasis is given on the uses of the plant or animal and on any other relations to man, for example, control methods. The drawings are excellent and the text is organized in a way that makes it quickly useful. This outstanding work by one of the leaders in the field of nature education will prove invaluable to scientists, conservationists, teachers, and laymen alike.

—Frank C. Edminster, *Upper Darby, Pa.*

FRONT PORCH FARMER. *By* Channing Cope. *Turner E. Smith & Co., 441 West Peachtree St., Atlanta, Ga. Pp. 198. Price $2.75.*

This book might well be called the proof of the conservation pudding. It outlines, in interesting detail, the conservation-type farming developed by the author, as the result of intensive study and constant experimentation over a period of twenty years. The book is as revolutionary as *Plowman's Folly*, and far more practical.

In front porch farming there is no yearly plowing and planting; there are no annual crops, no harvest days. While the income is derived from cattle, there are no silos, no hay mows; in fact, there are no barns. Labor costs are held to a minimum; very little machinery is required.

The farm plan is efficient because it makes full use of land resources; crops are selected and located with due consideration of land-use capabilities. To the fullest extent possible, the farm plan capitalizes climatic advantages—with due regard and respect for the idiosyncrasies of Old Man Weather. The system is weatherproof.

But *Front Porch Farmer* is more than just a book about a practical, new, and revolutionary type of conservation farming. It is the song of a man who loves the land and is happy because he has found a delightful way to protect and improve it. The book was written to share this plan with others. It will be enjoyed by all who are concerned with soil conservation and with the development of a permanent agriculture for our nation.

—Paul W. Chapman, *Athens, Georgia.*

WILDLIFE MANAGEMENT. *By* Reuben Edwin Trippensee. *McGraw-Hill Book Company, New York. 479 pp. 1948. $5.00.*

Here is a new textbook, divided into five sections: Farm Wildlife, Forest Wildlife, Wilderness Wildlife, Miscellaneous Wildlife Relationships, and Wildlife Administration. Each of the first three sections contains chapters devoted to the important game species occurring in farm, forest, and wilderness environments.

The fourth section deals with variations in numbers of wild animals, predatory relationships, game production and harvest, refuges, and winter feeding. The fifth section deals with wildlife administration, policies,

and training. The preface implies that a second volume treating fur bearers, waterfowl, and game fishes, none of which are discussed in this book, will be forthcoming.

Land managers will be disappointed in the first chapter "The Farm as a Wildlife Habitat." In it, several practices once recommended but now known to be impractical are presented as if they were still considered to be good management. Among them are annual food patches, flushing bars, the throwing of brush into gullies for erosion control, and the planting of willows and other water-loving shrubs and trees around farm ponds.

The planting of trees and shrubs seems to be overemphasized while the place of perennial herbaceous plants is almost completely overlooked. Such important land management practices as living fences of multiflora rose and wildlife borders of perennial lespedezas are not mentioned.

The chapter on "Wildlife Management in the Forest" seems to offer more practical management measures than the one on farm wildlife.

Of greatest interest and value to most readers are the chapters on individual game species. Here Dr. Trippensee has summed up and reported on a great deal of research work. His treatment of each species, giving geographical distribution, life history and ecology, mortality factors, and management recommendations, is good. The suggestions presented for food and cover development for each species help to compensate for the deficiencies noted in the general chapters dealing with farm and forest habitats, but even here, some of the more modern techniques are missing.

While the preface states that the book is an attempt to summarize and evaluate the wealth of new data that has been collected during the past decade, an analysis of the references cited fails to bear out the point. Of all the references cited with individual chapters 51 percent were published in 1938 or earlier and 71 percent were published in 1940 or before. The general references are more up-to-date, with only 44 percent being published prior to 1939.

In spite of the criticisms and limitations cited above, most readers will find much useful information in the book. Best of all, perhaps, they will find data relating to an individual species that have been collected from many widely scattered points, and are here presented side by side to facilitate comparison and evaluation. Everyone seriously interested in the subject should have *Wildlife Management* in his collection of references.

—WALLACE L. ANDERSON, *Milwaukee, Wisconsin.*

RANGE MANAGEMENT. *By* LAWRENCE A. STODDART *and* ARTHUR D. SMITH. *McGraw-Hill Book Company, Incorporated. 1943. 547 pp.*

Together the grazing and farming resources make up the pattern of agricultural production over the West. Use of grazing land seldom is completely pastoral but usually inter-related with a maze of agricultural pursuits. Wise management of the large area of United States grazing lands is imperative to security and improvement of soils on such land itself. Also this affects the welfare of the United States' hydroelectric developments, wildlife and recreational resources, forests, western irrigation agriculture, town and city supplies, inland water transportation and security of industry. This book, "Range Management", deals specifically with the grazing lands of the vast western part of the United States.

"Range Management" by Stoddart and Smith gives a comprehensive summary of the history, resources, problems and management needs of western ranges. It was written as a text for college students and as a reference for technicians and land operators. But, it is more than a source book for range men. It is good western Americana and solid American history. The text is well supplemented with illustrations, charts and tables.

Dr. L. A. Stoddart is Professor of Range Management of the Utah State College of Agriculture and Mechanical Arts at Logan, Utah. Arthur D. Smith is Dr. Stoddart's assistant.

Those who want a short-cut to the factual story of the western range country can find a lot of it in this book. Westerners can learn a lot about their home land too. The country east of the Mississippi River is different from the great range area in the west. The West has a peculiar physical and spiritual climate which have laid their mark on the people. Most of the United States' beef, mutton and wool is produced west of the Mississippi River; most of it is consumed in the East. In the eleven western states, 41 percent of the land is owned by the Federal Government. Eighty-two percent of Nevada is government owned. Stockmen graze the government rangelands at a stipulated fee per head per month. They are granted permits to graze animals during a specified period, usually in late spring, summer and early fall.

The authors of 'Range Management" give an informative review of the climate, soil, water and forage resources of the range country. It is a good guide book for Easterners who travel west and want to learn about the West's resources and land use as they travel.

The history of the western grazing industry is reported and includes information on wildlife, introduction of horses, cattle, sheep, famous livestock trails, sheep and cattle wars and the advent of barbed wire fences and settlement.

The authors combed the basic literature of the range

trade and briefed the information into readable form. A bibliography follows each chapter and there is a remarkably fine job of documenting reference material.

While the book is western in text there is much in the chapters on natural resources, management and conservation and western history that will be interesting to eastern pasture men.

A look at the chapter headings will make a curious man want to read the book.

—B. W. ALLRED, *Fort Worth, Texas.*

Crop Residues Conserve Soil and Water

(*Continued from page* 106)

to leave it on the surface as a mulch. Alfalfa grown by this method produced as large, or larger, yields of hay per acre as alfalfa grown on good land and cultivated by conventional methods.

Kurtz, Appleman and Bray (10) used growing plants for surface protection in growing corn. Second year red clover and sweet clover were turned under in narrow strips where corn rows were to be placed and the clover between the rows was clipped close to the ground when the corn was planted. The sweet clover was killed by this clipping and remained as a mulch on the unplowed strips between the rows. A modification with oats as the intercrop was also included. In the red-clover areas the clover grew tall enough to necessitate clipping a month and again six weeks after the corn was planted. All plots under this corn-clover association were paired with adjacent plots which were spaded and cultivated to simulate the conventional seedbed preparation and management.

Three series of plots were used in connection with both red clover and sweet clover. One series was untreated, one received nitrogen fertilizer and the other received nitrogen fertilizer and water. The corn yields for the different treatments are given in the following table:

Yield of Corn Under Different Management Systems

Intercrop	Bu. Per Acre Slit-crop system	Conventional system	Oats system
Red clover	69	126	
Red Clover + N	102	125	110
Red clover + N + water	130	135	

Intercrop	Bu. Per Acre Slit-crop system	Conventional system	Oats system
Sweet clover	116	132	
Sweet clover + N	116	130	120
Sweet clover + N + water	131	140	

Very limited trials with soybeans in the slit-cropping system were inconclusive. Although the yields were lower under the slit system, possibilities for good soybean yields were indicated whenever proper management techniques are developed. The corn yields doubtless would have been much higher on the slit-crop plots with red clover had the clover been clipped more often and the nitrogen and water applied at the proper time.

The advantages of a slit-cropping system may be great enough to warrant its use even though somewhat smaller yields may be obtained. This is particularly true for situations where erosion control and soil conservation are primary considerations. The possibility of reducing the plowing and cultivation currently necessary for corn production is alone sufficient to warrant further trials with a slit-cropping system.

LITERATURE CITED

1. Alderfer, R. B. and Merkle, F. G. The Comparative Effects of Surface Application Vs. Incorporation of Various Mulching Materials on Structure, Pemeability, Runoff, and Other Soil Properties. Soil Sci. Soc. of Amer. Proc., Vol. 8, pp. 79-86, 1944.
2. Borst, H. L. and Woodburn, Russell. The Effect of Mulching and Methods of Cultivation on Runoff and Erosion from Muskingum Silt Loam. Agr. Eng., Vol. 23, No. 1, pp. 19-23, January 1942.
3. Borst, H. L. and Yoder, R. E. The Trash Mulch Method of Reclaiming Broomsedge and Poverty Grass Lands with Alfalfa. Ohio Agr. Exp. Sta. Bimonthly Bulletin, Vol 28, No. 222, May-June 1943.
4. Copley, T. L., Britt, Clarence S., and Posey, W. B. Conservation Practices for Tobacco Lands of the Flue-Cured and Maryland Belts. USDA, Misc. Pub. No. 656, November 1948.
5. Duley, F. L. and Russell, J. C. Effect of Stubble Mulch on Soil Erosion and Runoff. Soil Sci. Soc. of Amer. Proc., Vol. 7, pp. 78-81, 1942.
6. Havis, Leon. Aggregation of an Orchard and a Vegetable Soil Under Different Cultural Treatments. Ohio Agr. Exp. Sta. (Wooster) Bul. 640, May 1943.
7. Hendrickson, B. H., Carreker, John R. and Adams, William E. Stubble Mulch in the Southern Piedmont, Soil Cons., Vol. 9, No. 6, pp. 139-141, December 1943.
8. Hendrickson, B. H. and Crowley, Roy B. Preliminary Results With Mulches Applied to Eroded Wasteland Sown to Lespedeza. Jour. Amer. Soc. of Agron., Vol. 33, No. 8, pp. 690-694, August 1941.
9. Kidder, E. H., Stauffer, R. S., and Van Doren, C. A. Agr. Eng., Vol. 24, No. 5, pp 155-159, 1943.
10. Kurtz, Touby, Appleman, M. D., and Bray, Roger H. Preliminary Trials With Intercropping With Corn and Clover. Soil Sci. Soc. of Amer. Proc., Vol. 11, pp. 349-355, 1946.
11. Lamb, John, Jr. Annual Progress Report 1948, pp. 30-31, USDA, Soil Conservation Service and New York Agri. Exp. Stas, Geneva and Ithaca.
12. Lamb, John, Jr., Andrews, J. S., and Gustafson, A. F. Experiments in The Control of Soil Erosion in Southern New York. New York Agri. Exp. Sta. Bul. 811, Ithaca, March 1944.
13. Moser, Frank. Soil Fertility as Influenced by Leguminous Plant Additions. S. C. Agr. Exp. Sta., Fifty-Fifth Annual Report, pp. 31-33, February 1943.
14. Peele, T. C. Influence of Mulches on Runoff, Erosion, and Crop Yields. S. C. Agr. Exp. Sta., Fifty-Fifth Annual Report, pp. 30-32, February 1943.
15. Van Doren, C. A., Lang, A. L., and Waggoner, M. E. Field Tests of Mulch Farming for Moisture Conservation and Control of Wind Erosion in Illinois. USDA-SCS and Ill. Agr. Exp. Sta., Multilithed, April 1945.
16. Van Doren, C. A. and Stauffer, R. S. Effect of Crop and Surface Mulches on Runoff, Soil Losses and Soil Aggregation. Soil Sci. Soc. of Amer. Proc., Vol. 8, pp. 97-101, 1944.
17. Woodburn, Russell. Reduced Loss of Soil, Less Runoff When Mulch Used. Miss. Agr. Exp. Sta., Farm Research, Vol. 6, No. 8, p. 7, August 1943.

Agronomic Practices in Relation to Wildlife

(*Continued from page* 116)

LITERATURE CITED

Anonymous
1948. Jackrabbits and Juniper, Soil Conservation Magazine, 13:9.
Bennett, Logan J.
1937. Grazing in Relation to the Nesting of the Bluewing Teal, Transactions, 2nd North American Wildlife Conference.
Bond, Richard M.
1945. Range Rodents and Plant Succession, Transactions, 10th North American Wildlife Conference.
1948. Correspondence.
Borell, A. E.
1948. Correspondence.
Bureau of Entomology and Plant Quarantine
1946. The Dependence of Agriculture on the Beekeeping Industry—A Review, U. S. Dept. of Agric., Agric. Res. Adm., processed.
Dambach, Charles A.
1945. Some Biologic and Economic Aspects of Field Border Management, Transactions, 10th North American Wildlife Conference.
Dambach, Charles A. and Good, E. E.
1940. The Effect of Certain Land Use Practices on Populations of Breeding Birds in Southwestern Ohio, Jour. Wildl. Mgmt. 4:1.
Dambach, Charles A and Leedy, Daniel L.
1948. A Recent Evaluation of Ohio's Wildlife Resources, Transactions, 13th North American Wildlife Conference.
Davison, Verne E.
1941. Wildlife Borders—An Innovation in Farm Management, Jour. Wildl. Mgmt. 5:4.
1948. New Techniques to Increase Bobwhites, Transactions, 13th North American Wildlife Conference.
Edminster, Frank C.
1941. Wildlife Management through Soil Conservation on Farms in the Northeast, U. S. D. A. Farmer's Bulletin No. 1868.
Gardner, Harry H.
1941. Field Unit Planning, Soil Conservation Magazine, 6:10.
Graber, L. F.
1936. Renovating Blue Grass Pastures, Circular 277, Ext. Serv. of the College of Agric., Univ. of Wisconsin.
Graham, Edward H.
1944. Natural Principles of Land Use, Oxford University Press.
1946. The Land and Wildlife, Oxford University Press.
Greenwell, Guy A.
1948. Wildlife Values of Missouri Farm Ponds, Transactions, 13th North American Wildlife Conference.
Haseman, Leonard
1946. Influence of Soil Minerals on Insects, Jour. Econ. Ent. 39:1.
Hopp, Henry
1946. Earthworms Fight Erosion, Too; Soil Conservation Magazine, 11:11.
Linsley, E. G. and MacSwain, J. W.
1947. Factors Influencing the Effectiveness of Insect Pollinators of Alfalfa in California, Jour. Econ. Ent. 40:3.
Murie, Adolph
1940. Ecology of the Coyote in the Yellowstone, U. S. Dept. Int. Fauna Series 4, Cons. Bull. 4.
Ohio Development and Publicity Commission
1944. Ohio—An Empire within an Empire.
Steavenson, Hugh A.
1946. Multiflora Rose for Farm Hedges, Jour. Wildl. Mgmt. 10:3.
Stoddart, L. A. and Rasmussen, D. I.
1945. Deer Management and Range Livestock Production, Utah Agric. Expt. Sta. Circ. 121.
Van Dersal, William R.
1937. The Dependence of Soils on Animal Life, Transactions, 2nd North American Wildlife Conference.
Vorhies, Charles T.
1937. Inter-relationships of Range Animals, Transactions, 2nd North American Wildlife Conference.

Legumes Increase Soil's Intake of Water

Cotton yield increases of 20 to 80 percent are becoming common on Texas Blackland Prairie farms following the use of winter legume cover crops as part of their soil conservation plan.

For example, on the Harry and Bill Porter farm at Terrell, cotton lint yields last year averaged 300 pounds per acre where vetch had been used two or more years preceding the cotton. Adjoining farms on which no winter legume crops had been used yielded only 100 to 125 pounds. Even on the Porter farm, which has been terraced and contour tilled for more than 20 years, the cotton yield averaged only 125 to 150 pounds of lint before vetch was used as a winter cover.

The soils producing these increases are in the Gray Prairies or "mixed lands" which occupy the transition belt between "black waxy" or true Blacklands and the sandy Forested Coastal Plains to the east. Some of these soils are heavy clays and some are lighter textured but common to both is a dense clay subsoil which permits only a very slow rate of water movement downward through the soil. Only moderately fertile to begin with, these soils have been left severely impaired as to productive capacity by water erosion and depletion from 40 years or more of continuous cotton.

Though it is acknowledged that terraces and contour cultivation are a necessary part of a sound conservation plan they can not do the whole job alone. A field which produces only a fifth of a bale of cotton an acre is not very profitable. A winter legume cover crop does double duty in that it covers up the land and prevents erosion

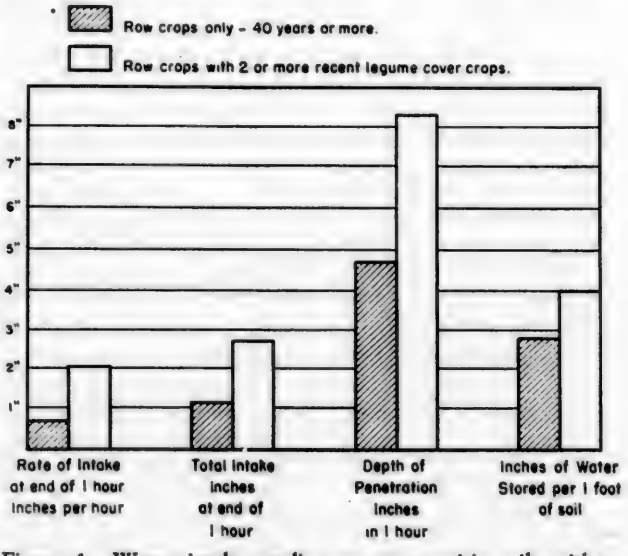

Row crops only - 40 years or more.
Row crops with 2 or more recent legume cover crops.
8"
7"
6"
5"
4"
3"
2"
1"
Rate of Intake at end of 1 hour Inches per hour
Total Intake Inches at end of 1 hour
Depth of Penetration Inches in 1 hour
Inches of Water Stored per 1 foot of soil

Figure 1. Water intake studies on gray prairie soils with tight sub-soils.

during the winter rains and increases yields of the following crops.

The value of rotation and soil improvement resulting from winter legumes is evidenced by the Porter farm records. These show that the cotton crop after three years of cotton and vetch yielded 600 pounds of seed cotton. Furthermore, three years of vetch (one harvested for seed and two volunteer crops turned under green) were followed by cotton that yielded 800 pounds of seed cotton, a 33 1/3 percent increase. One year each of Austrian winter peas, oats, and vetch turned under green ahead of cotton gave a yield of 800 pounds of seed cotton in 1948 when rainfall was below average.

How are cotton yield increases of 20 to 80 percent after a legume cover crop possible?

The answer to that is not fully understood but it is known that a legume adds a sizable amount of nitrogen to the soil as well as organic matter that stimulates growth of micro-organisms needed to maintain or increase fertility. But it is difficult to understand how a winter legume cover crop which averages eight tons an acre green weight can produce such big results. Of the eight tons of vetch turned under, 80 percent of the plant material is water. This leaves only 3,200 pounds of solids to be mixed with the 2,000,000 pounds of soil in a six-inch depth over an acre. This 0.16 percent by weight added to the soil causes the yield increase in the crops that follow.

Water intake observations during the late summer and fall of 1948 on land in cotton, both with and without preceding winter legume cover crops, cast considerable light on the why of the yield increases. The observations were made with concentric rings in which water was held at a constant level and the rate at which the soil took water was measured.

Rate of intake on the dry, undisturbed soils was measured and the test was continued for an hour. Then the total amount of water added was computed and the depth to which the soil was wet was measured. The results of these field tests are shown in the graph.

The rate of intake in inches per hour at the end of one hour is significant in that land with legumes preceding continued to take water more than three times as fast as land where no legumes were used. Under conditions of the test no runoff was possible, but under field conditions the low rate of intake on land with no legumess would obviously result in greater runoff and more washing of the soil.

The total intake and depth of penetration show the added advantage that legumes give the soil. The legumes improve soil structure and increase pore space. This enables the soil to take and hold more water in a given period of time. The graph shows inches of water stored per foot of soil. This value is obtained by dividing the total inches of water taken into the soil by the depth of the soil that was wet and multiplying by 12. The soil which had grown legumes two or more years actually held 1.2 more inches of water per foot of soil than that which had grown no legumes. This extra storage capacity is effective not just once each season but many times. At Temple, Texas, a 10-year average shows that each year there are seven rains heavy enough to produce runoff that fall two weeks or more after the preceding rain. This recharging of the soil moisture supply seven times gives the legume-improved soil an advantage of more than eight inches of extra moisture to deliver to growing plants. This extra moisture, held available for plant use, is part of every increased yield following the use of legume cover crops. The fertility added is valuable but the moisture to translate fertility into yields is a necessity.

The added water storage capacity of cultivated land which regularly grows a legume cover crop assumes considerable importance when the total of the 2,200,000 cultivated acres in the Gray Prairies is considered. Even if only half of this cultivated acreage were in cotton, the use of winter legume cover crops would increase production by about 388,000 bales, counting a 175 pound increase which is common where legumes are used.

In addition to the possible yield increase, the effect of this added water storage capacity on flood control is too significant to be disregarded. The eight inches of extra water held on the 2,200,000 acres of Gray Prairies or "mixed land" in cultivation represent 1,466,000 acre-feet of water subtracted from the runoff water which regularly overflows the creeks and rivers which drain the Blackland area.

The figures quoted are based only on the known amounts of the Gray Prairie portion of the Blackland, on soils which are underlain by very tight clays. These are the soils on which the water intake tests were run. Yields on the "black waxy" soils of the Blackland also show excellent results from legume cover crops but the effect on water storage has not been established.

Legume cover crops such as vetch and Austrian winter peas for the Gray Prairies, in addition to Hubam and Madrid sweetclover for the "black waxy" soils, fill a basic part of conservation farming in that erosion is controlled, nitrogen and organic matter are added to the soil, fertility is increased, and water available for plant growth is held in added quantities.

Conservation practices producing these results pay a farmer well.

—WILLIAM R. ELDER, *Temple, Texas.*

Loss of Topsoil Reduces Crop Yields

The lack of adequate close-growing ground cover to protect the soils is the most serious land use problem confronting the farmers of the Southeastern States. Without sufficient ground cover in our cropping practices on sloping land, we are losing valuable topsoil, and our crop yields are being gradually reduced.

It is obvious that each time the river water turns muddy following a rain, someone is losing precious surface soil. This soil is a loss to the owner of the field from which it came and a liability to owner of the farm where it is deposited. With the soil goes organic matter which contains many of the nutrients necessary for plant growth.

As the topsoil becomes thin the crop yields are reduced because the heavy clay subsoils do not have the fertility and physical condition to produce high yields of crops.

The results of 6 years of study with 36 crop rotations and 9 field tests on Cecil soil at the Southern Piedmont Conservation Experiment Station at Watkinsville, Georgia indicate that for each inch of surface soil lost there is a corresponding reduction in crop yields. As an example, the following table gives the 5-year average yields, 1944-48, for the same 3-year rotation on Class II and Class IV land.

	Class of Land II	Class of Land IV	Percent Reduction
Cotton (seed cotton), lbs. per acre	1240.	773.	37.6
Corn, bushels per acre	43.	26.	39.6
Oats, bushels per acre	68.	45.	33.8
Vetch (green tops), tons per acre	7.8	6.1	22.0

The rotation used was a 3-year succession, as follows: (1) cotton-vetch, (2) corn, and (3) oats (seed)—Kobe Korean lespedeza (for seed). Liming and fertilization were identical on both classes of land.

Figure 1.—Corn on Class IV land which has lost its top-soil produces very poor yields.

Figure 2.—Cotton on Class IV land with the same fertilizer as on Class II land, and often more labor, produces lower yields where the topsoil is thin.

The yield of cotton on Class IV land was 37.6 percent less than the yield of this crop on Class II land. Yields of corn, oats, and vetch green manure were, respectively, 39.6, 33.8 and 22 percent less on Class IV land.

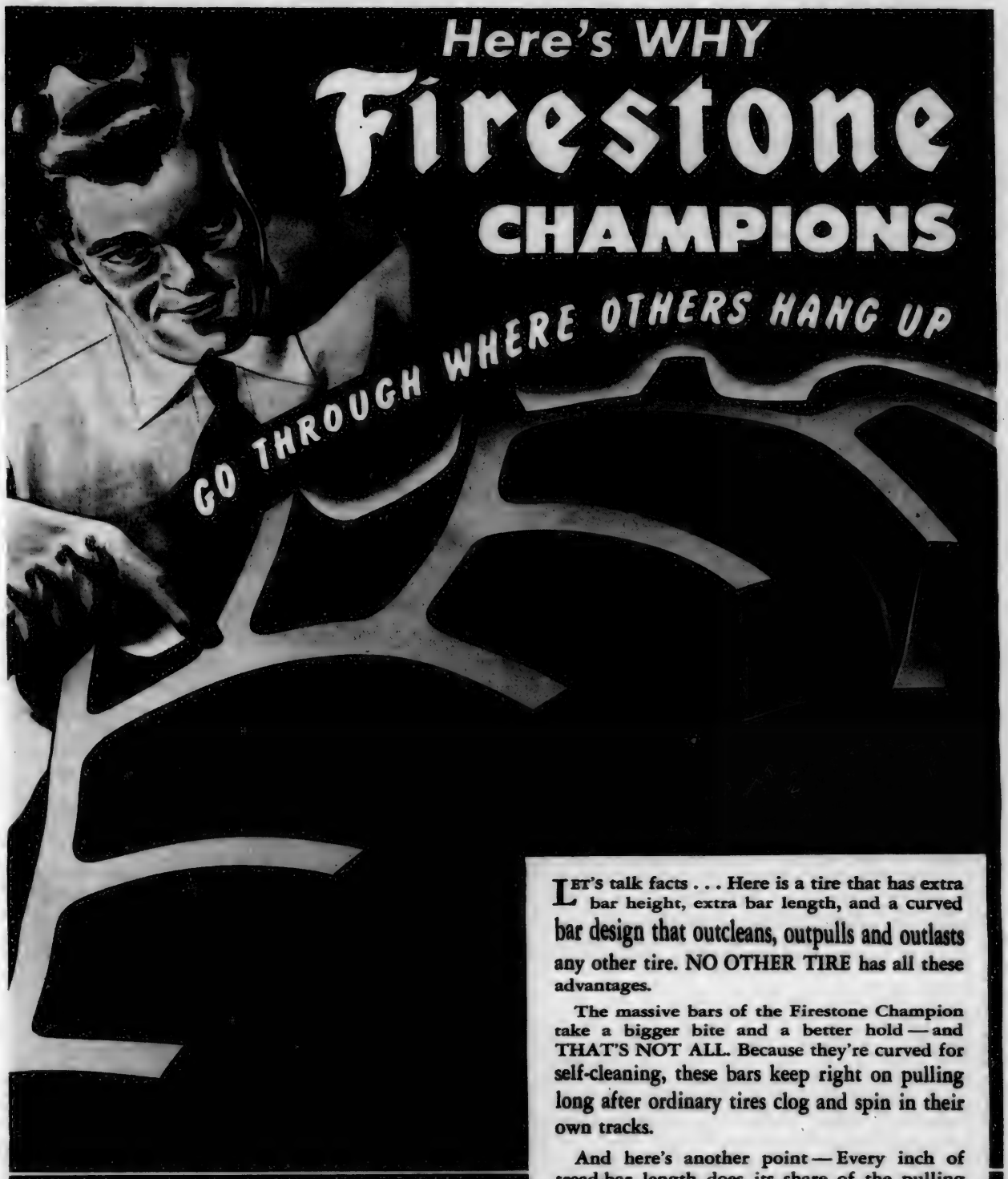
On the Class II plots, most of the topsoil was in place, whereas practically all the topsoil has been eroded from the Class IV plots. Careful measurements of the topsoil indicate that the Class IV plots have approximately 6 inches less topsoil than the Class II plots. Using the Class II plots as a basis, the reduction in yield per inch of surface soil loss for seed cotton, corn, oats, and vetch was as follows:

Cotton	104. pounds
Corn	2.7 bushels
Oats	3.8 bushels
Vetch green manure	560. pounds

The plots on both the Class II and Class IV lands received the same treatment. The fertilizer and lime used on both classes of land had the same chemical contents and were applied at the same rates. The same amount of labor was required to prepare the land, plant, cultivate and harvest the crops. Yet the yield of cotton on the Class IV land was almost 50 percent less than on Class II land. The corn, oats, and vetch showed similar marked reductions in yield.

The Class IV plots had about as much topsoil when cleared of the virgin forests as did the Class II plots. As a result of too-frequent row cropping over a term of years, practically all the topsoil has been lost. The 3-year rotation under test on these two classes of land does not contain sufficient ground cover for satisfactory conservation on Class IV land.

—WILLIAM E. ADAMS, *Watkinsville, Georgia.*



Here's WHY Firestone CHAMPIONS

GO THROUGH WHERE OTHERS HANG UP

LET'S talk facts . . . Here is a tire that has extra bar height, extra bar length, and a curved bar design that outcleans, outpulls and outlasts any other tire. NO OTHER TIRE has all these advantages.

The massive bars of the Firestone Champion take a bigger bite and a better hold — and THAT'S NOT ALL. Because they're curved for self-cleaning, these bars keep right on pulling long after ordinary tires clog and spin in their own tracks.

And here's another point — Every inch of tread-bar length does its share of the pulling because the low-pressure design of this tire puts ALL of the tread in FULL ground contact for a FULL TRACTION BITE. Because it's patented, the Firestone Champion gives you advantages which no other tire has. So . . . when it's time for a new tractor or for new tires, remember to use Firestone!

Listen to the Voice of Firestone every Monday evening over NBC and Americana over NBC Network Television Stations

Copyright, 1949, The Firestone Tire & Rubber Co.

THE 3 RULES FOR MAXIMUM TRACTION

1. USE FIRESTONE CHAMPIONS
2. USE FIRESTONE HYDRO-FLATION
3. USE ONLY 12 LBS. PRESSURE

From the Editor—

Plans are well underway for the Fourth Annual Meeting of the Soil Conservation Society of America which is scheduled to be held in St. Louis, Missouri, November 10, 11 and 12. Hotel Statler has been selected as headquarters. Howard Jackson of Columbia is Chairman of the Committee on Local Arrangments and Dr. E. H. Graham of Falls Church, Virginia, is Chairman of the Program Committee.

The officers of the Society along with local chapters and individual members everywhere are making elaborate plans to make this the most outstanding meeting of conservationists ever held. Dr. Graham and his committee are developing and organizing a program that truly emphasizes the science of soil and water conservation. They have obtained a number of outstanding scientists to appear on the program.

The National Fertilizer Association recently announced that *"Hunger Signs in Crops"* will appear on or about September 1, as an enlarged and revised edition. This publication will contain new and up-to-date information with a wealth of striking illustrations in full colors. The book sells for $4.50 per copy postpaid and may be obtained by writing to the National Fertilizer Association, Washington, D. C.

Many very excellent pamphlets have come across the editor's desk during the past several weeks. "Terrain," *among others, is a mimeographed publication published jointly by the Extension Service and the Soil Conservation Service. It contains a series of brief reports of conservation happenings in the States — many of which have local application. Another pamphlet is entitled* "The Story of a Lake" *issued by the Extension Service, University of Illinois. This pamphlet is based on the causes and effects of sedimentation in Lake Decatur.* "Water Spreading" *is the title of another very fine pamphlet just issued by the J. I. Case Company. It is well illustrated and emphasizes the different types of practices used to spread water. The Indiana Coal Producers Association has published a bulletin entitled* "Man-made Forests in Indiana." *It is the story of mining coal by the Open Cut method and restoring the land through reformation and other conservation methods.*

The Secretary reports that membership in the Society is growing, but not rapidly enough. Would it not be possible for "every member to get a member" between now and the annual meeting? There are many persons waiting to be invited. Vocational Agriculture teachers, librarians, Experiment Station workers and many others would profit greatly by becoming members of the Society.

Dr. Hugh H. Bennett, Founder of the Soil Conservation Society of America was recently awarded the John Deere Gold Medal for 1949 by the American Society of Agricultural Engineers for his great contribution to the cause of conservation. His many friends in the Society rejoice in this, his latest honor.

***"Natural Resources in World Affairs"* was the central theme of The Sixth Summer Lecture Series on Public Affairs held at the University of Michigan, June 27 to August 4. Six general subjects were featured during the lectures. They are: "Under All the Land," "Food, Forests, and People," "Minerals and National Security," "Energy Resources, Water and Modern Industry," "Governmental Policies in Relation to Natural Resources," and "Quo Vadimus." Each subject was presented by an outstanding authority. A report of the entire series of lectures may be issued by the University should readers be interested in learning more about the subjects presented.**

Readers of the JOURNAL *will be interested to learn that several new books featuring some aspect of conservation will be reviewed in forthcoming issues. Some of the books are:* "Liberty Hyde Bailey, the Story of American Plant Sciences," *by A. D. Rodgers, III;* "Soil, Food and Health" *Edited by Jonathan Forman;* "American Wild Turkey" *by Henry E. Davis; and* "Pastures" *by R. Y. Bailey and others.*

there's a **JOB** to be done

one that

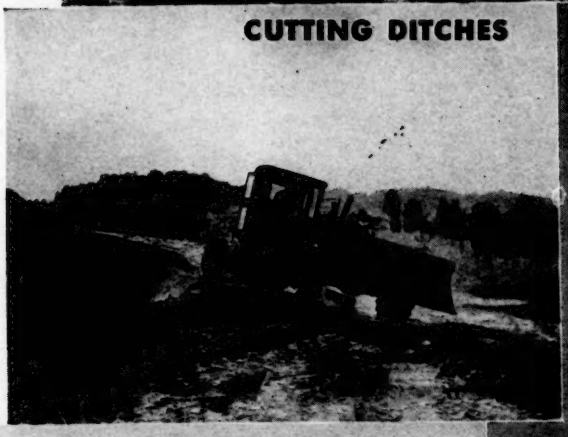
VERSATILE

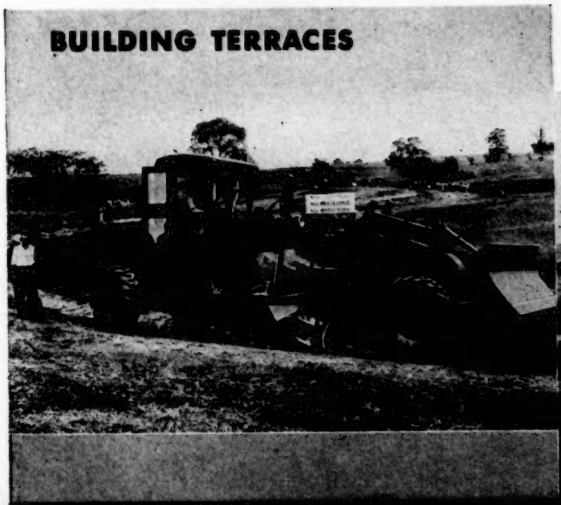
No single machine will do so many soil conservation jobs so easily, quickly and economically as the modern motor grader—especially an Austin-Western Power Grader with its exclusive All-Wheel Drive for maximum traction in rough or soft ground; 30% more "power-at-the-blade" and exclusive All-Wheel Steer for high speed turning and maneuvering in close quarters.

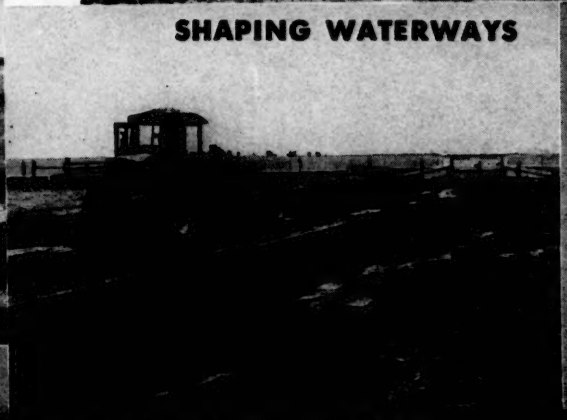
The bulldozer attachment has many uses... filling gullies, blocking the ends of level terraces, clearing out brush and small trees, etc.

Yes, for all-around versatility, you can't beat an Austin-Western Power Grader, and it *gets the job done.*

AUSTIN-WESTERN COMPANY
AURORA, ILLINOIS, U.S.A.







BUILDERS OF ROAD MACHINERY

Austin Western

SINCE 1859

Making Rain Stay Home!

With Home-Built Water-Spreading Systems

● Here is the latest J. I. Case Co. contribution toward better handling of run-off water. This new 10-minute film and a take-home booklet now released describe and picture the construction and operation of an actual water-spreading system in use on a farm in the Great Plains.

Such a system provides a double answer to water control problems: first, it spreads and slows run-off to prevent erosion; second, and equally important, it transforms the would-be flood into natural irrigation, spreading it thinly over the field and allowing time for necessary seepage into the thirsty subsoil.

Construction and maintenance of the system is carried out with farmer-owned and operated tractors and regular farm implements, such as moldboard and one-way disk plows.

Wherever you live, there are Case visual materials to help promote the best of advanced farm practices. Issued annually is this complete listing of films, booklets, charts. Write for your copy to nearest Case branch house, or Educational Division, J. I. Case Co., Racine, Wis.

CASE